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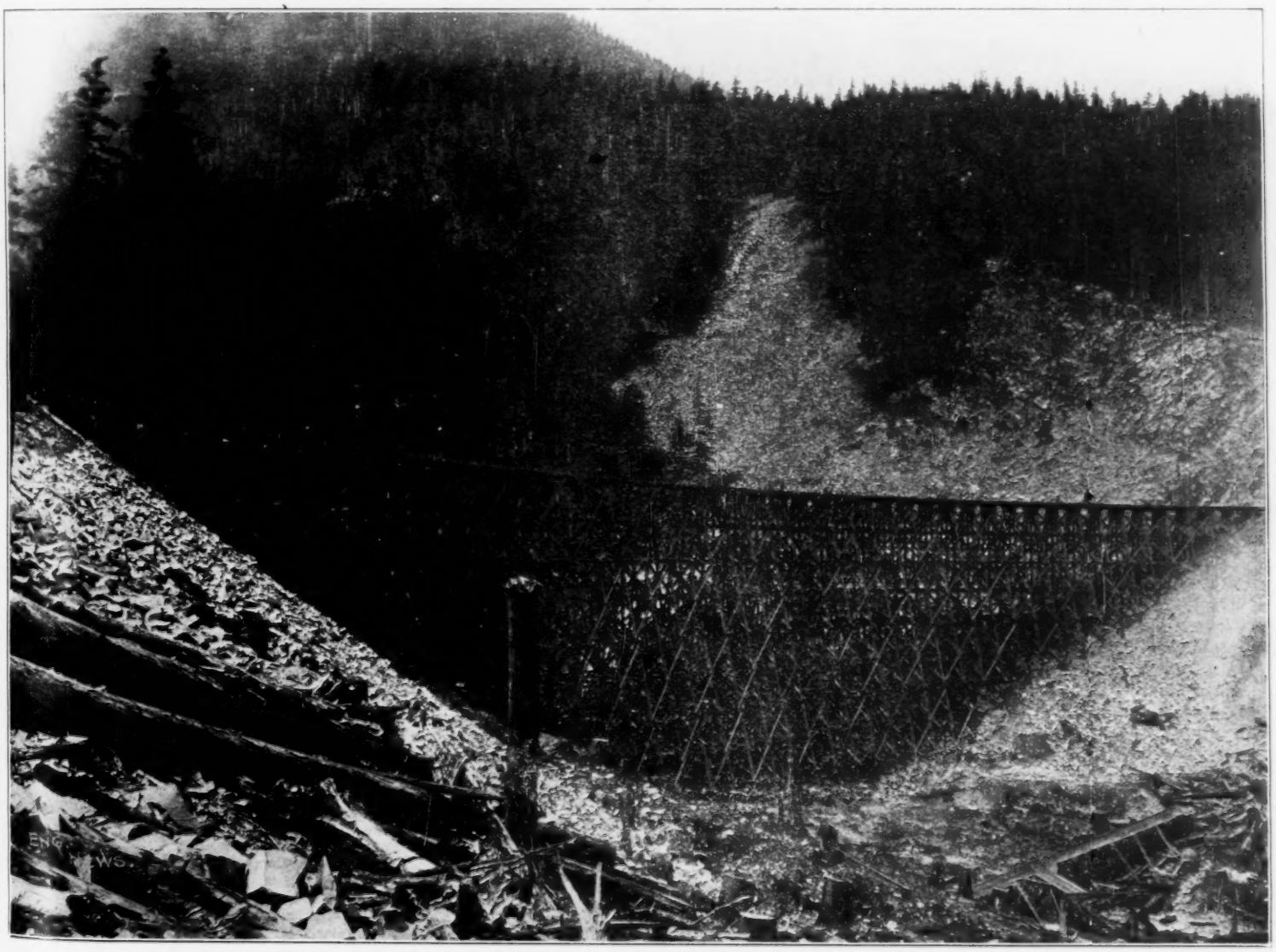
Large Timber Trestles on the Pacific Coast Extension of the Chicago, Milwaukee & St. Paul Ry.

The Chicago, Milwaukee & St. Paul Ry. has in process of construction what is known as the Pacific Coast Extension of its line from Evarts, S. D., to Seattle and Tacoma, Wash., a distance of about 1,500 miles. On a portion of the road, known as the Snoqualmie Line and extending from the summit of the Cascade Mountains down the west slope to Puget Sound, there are sections where the location has been rather bold and the consequent construction more of a pioneer nature than is usually found in present-day railroading. The accompanying views, taken along a portion of this route illustrate several of the large trestles which are very numerous along the line, and which comprise some of the highest timber trestles that have ever been built.



THE MINE CREEK TRESTLE, C., M. & ST. P. RY. (155 FT. HIGH, 1,250,000 FT. B.M. TIMBER).

In the particular stretch of road where these photographs were taken there are 23 bridges and trestles in 20 miles of a very rugged, mountainous country. Most of these were built of timber cut, to the amount of ten million board feet, along the right of way, by two mills, each having a daily capacity of about 40,000 ft. B.M. These mills, as well as all of the bridge iron and supplies, had to be carried by wagon "tote" road from the Northern Pacific Ry., in hauls varying from seven to twenty miles, at an average cost of about 1 ct. per lb.

The timber trestles are of standard form, with 12 × 12-in. posts, 12 × 12 in. intermediate caps, 12 × 14-in. caps and top decks, 10 × 18 in. × 32 ft. stringers, 8 × 8 in. × 12 ft. ties, 6 × 8-in. guard rails, 6 × 10 and 4 × 12-in. longitudinal girts and all other bracing 4 × 12 ins. These were

all spiked in place, no machine bolts being used in construction other than those in the guard rail. In construction, an aerial cableway was used, aided in places by a derrick (Fig. 4). In Fig. 3 the usual method of procedure is well shown. The pents were first framed and then packed in their proper location on the next lowest platform, with one wale and the top sway brace spiked permanently in place, to be spiked at the other end after erection. The stay planks were of 2 × 10-in. timber, and were spiked to the bent while the latter was down, so that when the bent was pulled into a vertical position the stay planks were ready to be spiked in place.

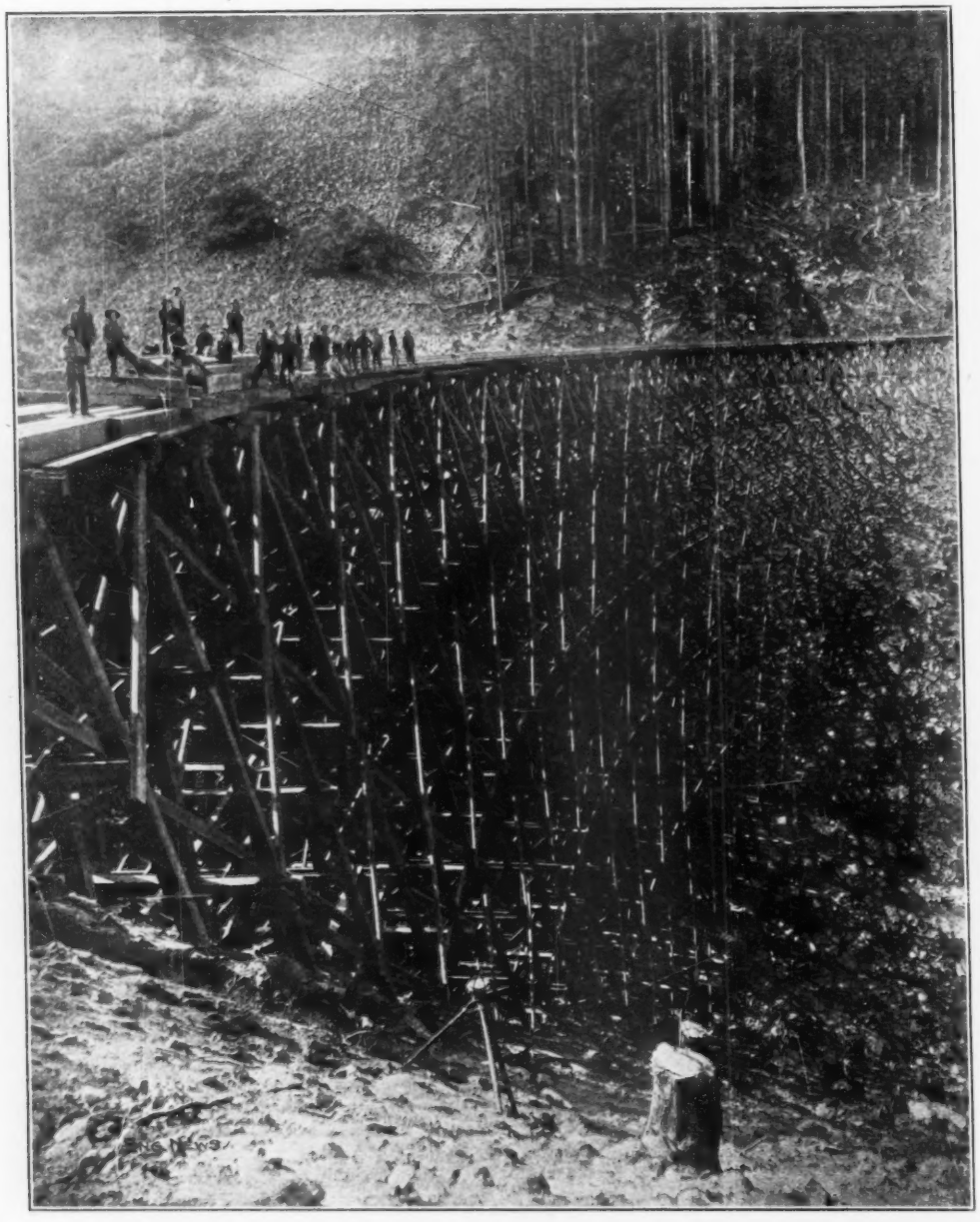


FIG. 2. A TIMBER TRESTLE, 190 FT. HIGH, ON THE PACIFIC COAST EXTENSION OF THE C., M. & ST. P. RY.

In the views, Fig. 2 shows Heason Creek trestle, which stands 190 ft. above the creek bed that it crosses. Fig. 1 is the Mine Creek trestle, with 1,250,000 ft. B.M. of timber and standing 155 ft. high. Fig. 3 is the Change Creek trestle, about 160 ft. high. Fig. 4 is the beginning of the Butt's Creek trestle.

The greater part of this portion of the work was done in six months during the summer of 1908, by J. M. Bruce & Co., Seattle, Wash., as bridge contractors under H. C. Henry, who held the general contract for construction of the line from Idaho to the Pacific. The photographs were kindly forwarded to us by J. M. Bruce & Co.

A DIVISION OF IRRIGATION for the Philippine Islands has been created in the newly organized Bureau of Public Works, according to the U. S. Reclamation Record for March, 1909. Irrigation surveys are in progress and construction is proposed.

Committee Reports: American Railway Engineering and Maintenance-of-Way Association.

Nearly all the committee reports presented at the annual meeting of this association in Chicago (March 16 to 18) were of considerable length, and several of them treated of three or four subjects. It is impracticable to present all these in abstract in the space at our disposal, but we give herewith some extracts relating to certain specific subjects. Further abstracts of some of the reports will be given separately, and a general review of their subject matter is given in our report of the proceedings:

Wooden and Steel Tanks for Railway Water Stations.*

The life of white pine tubs used in the past does not exceed 20 years. The quality used at present is inferior and will have a life of less than 20 years. The price has been increasing rapidly, even with the use of inferior lumber.

The life of cypress used in the past does not exceed 25 years; the quality at present is as good as in the past. The price has been rapidly increasing. Further increase in the price of wood tubs is to be expected in view of the rapid depletion of forests. The use of wood in tubs limits the capacity of same.

The use of steel for tanks at water stations between terminals has not been general, and at terminals only to a limited extent, usually when forming a part of a fire or general water supply system. In recent years there has been considerable development along this line and a number of tubs constructed. The life will depend on kind of material and water. The use of metal standpipes for city water supply has extended successfully over a large number of years, which presupposes satisfactien with railway tanks where the pressure is much less.

The metal specified in most of the recent railway tanks is open-hearth steel, and the life of such tanks will depend on the effect of the water. There are without doubt singular cases where the only water available, although corrosive, is used in locomotives; but such conditions are infrequent, will pass with extension of treatment, and call for special consideration.

A 16 × 30 steel tub of ¼-in. and ⅜-in. plates was erected in 1868 at the 47th St. shops of the Chicago, Rock Island & Pacific Ry., at Chicago. Although painting was very much neglected, the tub is still in service, with the prospect of doubling the present life, since only a shallow depth of pitting has occurred inside, and the outside is now being maintained. The tub was corroded most where it rested on the timber joists. A manufacturer of steel tanks gives as a conservative estimate of the life, five times that of wood, which he places at 10 or 15 years.

The prevailing size of wooden tub is 16 ft. high by 24 ft. diameter, commonly called a 50,000-gal. tub. In recent years, tubs 20 ft. by 30 ft. in diameter, designated as 100,000-gal. tubs, have been erected to some extent. Additional storage is secured by a battery of tubs of those sizes, this being due to the limit placed by difficulty in securing larger timbers.

The use of steel water tanks removes the limit placed on the size of wood, and as their use is growing the sizes of the units will be determined by the relation of consumption, cost of installation and cost of operation.

Ordinarily it is cheaper between terminals to provide storage capacity to carry over night than to use a night pumper. This requires consideration of probable increase above the maximum consumption within the life of the tub. It is believed that the consumption will in most cases at least double in 20 years, and therefore the unit would be at least 50% greater than the maximum daily consumption, which will avoid a night pumper for a considerable period without undue expense of installation, which could be offset when installed by the pumper operating two or more stations.

Track Tanks.*

The committee has received plans of six different standards of track tanks. These have been analyzed and compared, with the following results:

All are located on tangent. Track pans have, however, been installed on curves up to 2°.

All are fastened to track ties from 8 × 9 ins., 8 ft. long to 8 × 10 ins., 8 ft. 6 ins. A 2-in. dap in tie is generally made to bring top of tank level with top of rail.

The length varies from 1,200 to 1,800 ft.

The widths in clear at top are 19 ins. (4), 25 ins. (1) and 23¾ ins. (1). The depths are 6 ins. to 7 ins. Four have straight sides and two have return lips made of channels or angles. The 19-in. section seems to give the best results.

The end inclines vary as follows: The portion beyond the pan extends from 4 ft. to 6 ft. and the portion in the pan from 6 ft. to 10 ft. In part of the plans the rate of incline is different, depending on whether it is an entrance or exit.

In all cases the water connections enter in bottom of pan. Size from 4-in. to 6-in. Expansion and contraction taken care of in five cases by rubber hose, and in one by a packed joint. Various styles of inlets: one has 2 holes 4 × ¾ × 3½ ins., with a deflector directly over inlet; one has an enlarged pipe from 6 ins. to 11 ins., with no deflector; one has a large box arranged with a deflector at top; two have a large number of ½-in. to ¾-in. holes in bottom plate.

All are heated by steam. One uses the injector principle and heats water by jet of steam before it enters pans. Three admit steam through ⅛-in. to ¼-in. nozzles pointed downward at sides of pan every 30 or 40 ft.

Grade Crossings in Paved Streets.†

For crossings where paving is required to conform to street specifications, the ties should be treated chemically to prolong their life to the greatest limit possible. They should be laid on a bed of stone or slag ballast, not less than 12 ins. deep, placed in 3-in. layers, each thoroughly rammed so as to prevent settling. An 8-in. bed of concrete (1:3:6) can be substituted for the ballast.

With the ballast and outside of the tracks, porous tile drains not less than 6 ins. diameter should be placed at intervals, leading to the nearest point from which efficient drainage can be obtained.

The support of the rail on the ties will vary with the character of paving. If stone blocks are used, a substantial cast or malleable steel chair, with a base of not less than 48 sq. ins., should be provided, fastened to the tie with suitable lag-screws, the rail fastening

*From report of the Committee on Water Service.

*From the report of the Committee on Water Service.
†From the report of the Committee on Signs, Fences, Crossings and Cattleguards.

Fig 3. Method of Erecting Timber Trestles on Snoqualmie Line of C., M. & St. P. Ry.

to be a hook-headed bolt secured with nuts. Ties should be spaced so as to allow the joints to be supported by these chairs.

On long stretches of track laid in streets paved with stone blocks, the use of a special rail section, not less than 9 ins. in depth, is advisable, to avoid the use of the chairs mentioned. With such a rail, heavy tie-plates should be used as a protection to the ties.

On the outside of the rail, the block paving should be laid up to the level of the rail-head, but left slightly below it on the inside. An old rail or a suitable form of rolled filler should be placed to provide a flangeway, this to be fitted into the space between the head and base of the track rail. If an old rail is used, the flange should be placed as nearly vertical as possible, the paving between the rails to be limited by the flanges or fillers. The flangeway rail or filler should be supported by the same chairs carrying the track rail, with a clear opening of not less than 2 ins. Where a special rail section is used, the flangeway should be rolled as a part of it.

With asphalt paving and brick paving, the ties should be similar to and have the same foundation as described above, except that with rails of high section, the use of the cast chairs is unnecessary. A heavy tie-plate should be placed on each tie where the ordinary track rail is used.

A strip of treated timber 4 × 6 ins., fitted to the rail and placed so as to expose 3 ins. of surface next to the rail-head, should be used next to the outside rail, and this should be paved against. The strip should be ¼-in. below the rail-head. Metal flangeways should be provided as described above, and paved against in like manner.

Paving between and outside of the rails should be laid in the most approved and workmanlike manner.

Railway Construction in Relation to Snow.*

In the location and construction of railways through snow country special attention is given by the locating and construction engineers to provide against difficulties in the operation of the railway on account of snow. An embankment 2 ft. above the surface of the ground is generally sufficient.

Snow slides in mountainous country are given full consideration and, if possible, the railway is located either to avoid them or to provide for an economical snow-shed construction. In some cases the railway has been carried over snow slides, which occur in ravines, by means of spans. This method, however, has proved disastrous in a number of cases, as the spans were carried out or wrecked by the large trees that were brought down with the slide.

A very successful method has been adopted on many railways to escape snow accumulating in deep cuttings by borrowing material which they require for widening banks, filling trestles, etc., from the sides of cuttings into which snow had been drifting. A steam-shovel cut on the windward side has been sufficient to give ample space for the drifting snow to accumulate and keep clear of the tracks. In this connection it is interesting to note that snow seldom accumulates in rock cuttings that are 25 ft. or more in depth. In these cases the precipitating snow seems to be blown out of the cuttings by deflected air currents.

*From the report of the Committee on Signs, Fences, Crossings and Cattleguards.

Signal Protection for Drawbridges.*

The protection of train movements over drawbridges by interlocking is by no means a new departure in signaling, but very little progress has been made toward the establishment of uniform methods of application, the different methods in vogue having been considered good practice by all roads employing them.

The strides that have been made in the development of railway signaling devices in recent years are remarkable, but it is notable that until recently very little improvement has been made in the locking of drawbridges and lift rails. It seems strange, in the midst of all the achievements in signal devices, that a matter of such obvious importance should have received such scant attention.

In connection with drawbridges (from a transportation standpoint) the points of least security are the lift rails at their junction with the shore rails. As every consideration of safety demands that the track over the draw be as substantial as at any other point, we find the inevitable slow sign with its consequent interference with the up-to-date movements of trains as a result; and in numerous instances, a full stop, before crossing the draw, is deemed a necessary precaution.

In order to eliminate the conditions of least security, the lift rails should be connected in such a manner as to make it necessary for them to be in perfectly proper and safe position, both laterally and vertically, before they can be locked and signals given to proceed over the draw. It is important that the locking device provided be of a simple and appropriate design so that its maintenance will introduce no complications.

It is also necessary to prevent the application of power for the purpose of withdrawing the bridge latch or opening the draw while the lift rails are locked and signals indicate proceed.

Having in mind the lack of uniformity as described in the foregoing, your committee has endeavored to formulate such recommendations as would have a tendency to reduce to a minimum the number of different methods of application. But owing to the many different designs of drawbridges and methods of operation, we are unable to recommend any standard apparatus or methods of locking that would be suitable for all, and owing to the different requirements and conditions at different points, we cannot consistently recommend any uniform arrangement of signals, etc.

The standard specifications for mechanical interlocking have been so rearranged as to apply to about all drawbridge interlocking installations, so that we do not consider any special clause on this account necessary.

The following are the drawbridge recommendations which we submit:

Signals.—Signals shall be provided for all routes approaching the draw and shall be located not less than 500 ft. from draw in direction of traffic, and 200 ft. from draw in reverse direction, unless state or federal authorities prescribe otherwise.

High home signals with adequate approach information should be provided for current of traffic and dwarf signals for reverse and other routes approaching the draw.

Locking.—A locking arrangement shall be provided for each of the following purposes before signals can be cleared: (A) to insure that the bridge is in proper alinement; (B) to insure that all bridge surfacing devices are in their proper position; (C) to lock each rail in proper position for train movement; (D) to prevent the application of power for purpose of withdrawing bridge latch or opening draw.

*From the report of the Committee on Signaling and Interlocking.

FIG. 4. START OF CONSTRUCTION OF TIMBER TRESTLE ON NEW LINE IN STATE OF WASHINGTON.

The committee considered the subject of rail locks, and on account of the different styles of drawbridges it was deemed inadvisable to recommend any particular locking device. Each case would have to be taken up on its own merits.

Pile Driving and Steel Sheet Piling.*

The most prevalent bad practice in pile driving is overdriving; that is, injuring the pile by too violent or too continued hammering. When such injury occurs above ground, in the form of brooming or splitting, and can be prevented by the use of rings or caps, it is regarded as an indication of overdriving. The use of such protective appliances as rings, caps, or shoes is a legitimate means for securing the necessary penetration of softwood timber and of even hardwood timber in difficult ground. When, however, the resulting injury occurs below the surface of the ground, and therefore in that portion of the pile which will be a part of the finished structure, the pile may be said to be overdriven. Injuries of this nature may consist of a slight brooming at the foot of the pile, and so be negligible; or they may be of sufficient importance to imperil the stability of the structure.

There are several types of failures. In one case piles were almost shredded into their component fibers for considerable lengths. Another sheared longitudinally, allowing the broken ends to pass each other and resulting in a pile whose length was merely that of the upper portion. Still another buckled locally, forming an elbow joint, and remained attached to the lower section.

It is frequently claimed by contractors and their foremen, and with apparent reason, that engineers specify conditions regarding penetration due to the last blows which are too severe. Pile driving can never be an an exact science, and the "practical man" seems to have some reason for his poor opinion of a specification which applies with equal force to every known and unknown condition of the ground.

Unfortunately, it is sometimes difficult to distinguish between the action of an overdriven pile and that of a perfectly sound pile in certain ground. Practice in the art and some investigation of the underlying conditions are perhaps the surest guides to success.

In general, overdriving may be due to one or more of the following causes: (1) the use of the word "refusal" in the specifications (2) a belief in the prevalence of intermediate or floating hard strata; (3) the use of a light hammer and a long drop; (4) attempting to force aside mythical small boulders; (5) an unnecessary effort to make the pile-driving record suit a formula which was not intended by the proposer thereof to apply to such cases.

It is usually claimed, in cases of overdriving, that no evidence of injury was shown during the driving. This claim is open to considerable doubt, and a more careful examination of the underlying strata should prevent many failures.

A pile passing through soft material and bringing up on rock cannot be driven into the rock. This condition indicates that another type of foundation may be needed. Pile foundations in ground hard enough to broom and split hardwood piles can often be otherwise designed with advantage.

*From the report of the Committee on Wooden Bridges and Trestles.

Many kinds of ground, easily penetrated under continual driving, develop a skin friction in excess of the probable requirements. Short, quick blows of a heavy hammer produce the best results. A sudden change in the amount of penetration should be considered a suspicious occurrence. Finally, pile driving is a means, not an end, and a whole pile in almost any ground is better than pieces of a pile in good ground.

METAL SHEET PILING.—The first metal sheet piles were probably those used by Mathews in England, about 1822. In that year the first patent was granted to Ewart for a cast-iron sheet pile of the ball and socket type. Subsequently other types were made of cast-iron, but owing to the character of the material no very extended application occurred.

With the more widespread use of steel, various inventors turned their attention to the subject. The first rolled section of sheet piling patented in the United States was the ball and socket arrangement devised by Lewis Dodge in 1870. This was the forerunner of the "United States" type patented by S. K. Behrend in 1899, and of the many subsequent varieties of interlocking rolled sections. In 1893, August Simon, of Gnadau, Germany, patented the first of the built-up sections, which in a modification now known as the "Jackson" type, was the first steel sheet piling driven in this country (Randolph St. bridge, Chicago, 1901). Further modifications of the built-up construction followed: the interlocking channel "Friestedt" type in 1902, the beam clip "Friestedt" type in 1903, and the succeeding modifications of various inventors.

A surprisingly large number of patents have been taken out for steel sheet piles, some of which are merely protecting patents and many of which are not on the market. Some types are not commercially practicable, owing to difficulties in manufacture, while others have not been brought forward in competition with more established makes.

Roundhouse Construction, Heating and Ventilation.*

REINFORCED-CONCRETE ROOF.—By this we mean a roof which is supported also by reinforced-concrete beams. Such a roof, properly constructed, is not porous enough to allow leaks or to permit gases and moisture to corrode the reinforcement, except as it may crack. The cracks can be kept at a minimum, and (it is believed by some engineers) so prevented that the roof shall stay waterproof without any covering by reinforcing it against all the tension stresses due to expansion and contraction. To do this it is very important that the reinforcement be properly located. During the past two years some large buildings have been erected on this theory, and so far they are giving excellent results. But the committee cannot yet recommend a concrete roof without a covering on top of the concrete, although in a roundhouse where a leak cannot do serious damage, more risks can be run than with some other buildings.

Fear has been expressed that the reinforcement might be damaged by the corrosive gases present in a roundhouse. The committee is of the opinion that, unless the roof leaks badly, any pores in the concrete will be closed by the cementwash or whitewash put on after the house is completed, or else by soot, and that there is no chance of damage from this cause.

Condensation of the underside of the roof during cold weather does not take place with a concrete roof when the house is properly heated, and there is no more condensation than with a wooden roof. The modern roundhouse is now being equipped so that the steam and smoke is carried off without allowing it to escape into the house, decreasing the chance of trouble from this cause. Any chance of damage to the reinforced concrete by the absorption of the water of condensation on the ceiling is very remote and not worth considering.

But few roundhouse roofs have been built exclusively of reinforced concrete, and only one has been in use much over two years. As far as we can learn, the results have so far been entirely satisfactory.

HEATING.—As the thawing out of the engines that they may be returned to road service with greatest possible dispatch is the prime function of the heating plant, all considerations as to the location of the heat should be subordinated to this. For this reason the heat should be introduced at the pits in order to concentrate it there. Advantage is also obtained by putting it at the lowest possible point in the house, making its usefulness for inducing and forcing ventilation a maximum.

An enginehouse is not intended to be a rest room or a club room, and there is no need to provide the warmth that makes its use for such purpose practicable. The men regularly employed in enginehouses are always warmly dressed and will work faster and better if the house is not too warm.

We are cognizant, however, of the fact that good results can be and are obtained by the use of steam heat supplied through coils in the pits. Some scheme for producing a positive circulation is required, and for this purpose the vacuum return system seems best adapted. With this system the steam is circulated at lower pressure than by direct steam, which will, we believe, make the maintenance charges lower, although still considerably higher than if the hot air system is used. This vacuum return system has been in general use for only a comparatively short time, so that we cannot as yet substantiate our opinion with figures.

Where steam coils in the pits are used, great care must be taken with the design of the pit to prevent water from splashing on the pipes, which then forms a fog in the house, and also tends to crack the pipes, thereby causing leaks in the system. Special care must be taken also to insure sufficient ventilation on account of the lack of a positive air change. While the steam heat system is cheaper to install than is an adequate hot-air plant, the maintenance cost of the steam heat system is larger. (1) Heat should be concentrated at pits. (2) The general temperature should be kept between 50 and 60°. (3) The best method for heating is by hot air driven by fans through permanent ducts (under the floor where practicable). The supply should be taken from the exterior of the building (no recirculation should be allowed). The air should be delivered to the pits under the engine portion of the locomotive. Air to be heated as far as may be by exhaust steam, supplemented as required by live steam.

VENTILATION.—To accomplish the removal of foul air and gases, a continuous upward movement must be secured (no recirculation of air to be permitted).

*From the report of the Committee on Buildings.

UNIT STRESSES FOR STRUCTURAL TIMBER EXPRESSED IN POUNDS PER SQUARE INCH RECOMMENDED BY THE COMMITTEE ON WOODEN BRIDGES AND TRESTLES.

Kind of Timber.	Bending: Extreme Fibre Stress. Average Ultimate.	Bending: Safe Stress.	Modulus of Elasticity. Average.	Shearing: Parallel to Grain. Average Ultimate.	Shearing: Parallel to Grain. Safe Stress.	Shearing: Longitudinal Shear in Beams. Average Ultimate.	Shearing: Longitudinal Shear in Beams. Safe Stress.	Compression: Perpendicular to Grain. Elastic Limit.	Compression: Perpendicular to Grain. Safe Stress.	Compression: Parallel to Grain. Average Ultimate.	Compression: Parallel to Grain. Safe Stress.	For Columns Under 15 Diams. Safe Stress.	Formulas for Safe Stress in Long Columns Over 15 Diams.	Ratio of Length of Stringer to Depth.
Douglas fir	6,100	1,200	1,510,000	690	170	270	110	630	310	3,600	1,200	900	$1,200\left(1-\frac{L}{60D}\right)$	10
Longleaf pine	6,500	1,300	1,610,000	720	180	300	120	520	260	3,800	1,300	980	$1,300\left(1-\frac{L}{60D}\right)$	10
Shortleaf pine	5,600	1,100	1,480,000	710	170	330	130	340	170	3,400	1,100	830	$1,100\left(1-\frac{L}{60D}\right)$	10
White pine	4,400	900	1,130,000	400	100	180	70	290	150	3,000	1,000	750	$1,000\left(1-\frac{L}{60D}\right)$	10
Spruce	4,800	1,000	1,310,000	600	150	170	70	370	180	3,200	1,100	830	$1,100\left(1-\frac{L}{60D}\right)$	—
Norway pine	4,200	800	1,190,000	590	130	250	100	—	150	2,600*	800	600	$800\left(1-\frac{L}{60D}\right)$	—
Tamarack	4,600	900	1,220,000	670	170	260	100	—	220	3,200*	1,000	750	$1,000\left(1-\frac{L}{60D}\right)$	—
Western hemlock	5,800	1,100	1,480,000	630	160	270*	100	440	220	3,500	1,200	900	$1,200\left(1-\frac{L}{60D}\right)$	—
Redwood	5,000	900	800,000	300	80	—	—	400	150	3,300	900	680	$900\left(1-\frac{L}{60D}\right)$	—
Bald cypress	4,800	900	1,150,000	500	120	—	—	340	170	3,900	1,100	830	$1,100\left(1-\frac{L}{60D}\right)$	—
Red cedar	4,200	800	860,000	—	—	—	—	470	230	2,800	900	680	$900\left(1-\frac{L}{60D}\right)$	—
White oak	5,700	1,100	1,150,000	840	210	270	110	920	450	3,500	1,300	980	$1,300\left(1-\frac{L}{60D}\right)$	12

NOTE.—These unit stresses are for a green condition of timber and are to be used without increasing the live load stresses for impact. *Partially air-dry. L = length in inches. D = least side in inches.

This can best be accomplished by designing the roof so that the "slope-up" is given to a continuous opening around the house and by the use of annular openings around the smoke jacks. To obtain the full value of these continuous openings the purlins and rafters must be arranged so that they will guide the air currents up to the openings instead of obstructing them. The replacement by fresh air is most surely accomplished by hot-air heating. Where no heating is needed, openings can be provided of such size that no mechanical ventilation will be required.

SMOKE REMOVAL.—By this we mean the removal of gases and smoke coming from the stack of a locomotive. Ventilation and smoke removal are dependent upon a correct design of the house and of the smoke jacks. Smoke removal should be separately provided for by the use of jacks, and the currents produced in the jacks should be utilized for aiding ventilation in the house by drawing air from the top of the house through annular openings leading into the top of the jack. Jacks should be without dampers, fixed, and built of non-corrosive material with cross-section not less than 30 ins. diameter. They should be of smooth material, circular in section above the hood, and extending well above the roof line. Care in design should be taken to avoid any corners.

The hood of a jack should have a minimum length of 10 ft., so as to permit variation of location of an engine on the pit. The bottom of the jack should be as low as the engines served will allow, and it should be furnished with a drip trough. The slope upward should be gradual to the flue.

In designing the cross-section of an enginehouse conforming to these requirements, care should be taken to see that the section is such that sufficient light can be obtained in the house to permit of necessary work around the engines without the use of artificial light in the daytime.

The Preservative Treatment of Ties and Timber.*

Creosoting may be relied upon to preserve piles for from 20 to 25 years (or more) if they are injected with 16 to 24 lbs. per cu. ft. At present it cannot be relied upon to preserve ties more than 15½ to 19 years (an absolute maximum) unless the ties are protected against mechanical destruction. If badly injected, they perish from decay in 5 to 12 years.

Burnettizing when well done can be relied upon to preserve ties from 10 to 14 years. The amount to be injected varies with the proposed subsequent exposure. In arid climates, ¼-lb. of dry zinc chloride per cu. ft. may give good results. In moist and warm climates, not less than ½-lb. per cu. ft. should be injected.

The zinc-creosote process has been too recently introduced (1904) in this country to give definite conclusions; it has given ties a life of 12 to 18 years in the track in Germany.

The Rueping and the Lowry processes are too recent to form definite opinions as to the resulting life of ties.

Great waste and disappointment will result unless accurate records are kept (for ten years at least) of the results in the track, connecting them with the way in which the work has been done. The best method of identification is by dating nails.

It is indicated by the statistics that a treated tie or timber may be destroyed by mechanical action long before it is decayed. The present general American method of rail fastening is not ample and not efficient. It is essential in order to obtain the full economic life of a preserved tie to improve the fastening by providing greater bearing surface and by the use of screws or screw spikes. It is evident from present results that economic life of treated ties cannot be obtained without an improved rail fastening.

The preparation of the timber for treatment (seasoning, in other words) needs consideration. Some very serious questions in the deterioration of timber while undergoing seasoning now confront railways which had adopted tie treatment. The proper handling of ties and timber prior to the injection of preservatives should have immediate attention. There is found to be no sound knowledge as yet on the effect of treatments on the strength of timber.

CONCLUSIONS.—Coal-tar creosote and zinc chloride are efficient preservatives when properly applied and when used under proper conditions.

It is necessary to keep better records than have been kept so far in order to form proper conclusions as to the merit of different methods and processes.

Preserved wood may be destroyed by mechanical action long before it is decayed.

It is essential that timber for treatment should be properly grouped, in order that a successful treatment may be obtained. The species, proportion of heartwood and sapwood, condition of the timber with respect to its moisture content, and the wood structure, will in general determine this grouping.

It is desirable to air-season timber in order to prepare it for treatment. Most woods can be best treated after being air-seasoned.

*From the report of the Committee on Wood Preservation.

Unit Stresses for Structural Timbers.*

The accompanying table contains the ultimate and safe unit stresses recommended by the committee. Unless otherwise stated the ultimate stresses are the average values for green timber. In cases where it was not possible to secure results for green timber in large sizes, those for partially air-dry timber are inserted in the table.

It is expected that these unit stresses will be revised at intervals of a few years, whenever new results of timber tests are published, or when the experience of bridge engineers who have adopted them shall indicate that revision is desirable.

Facing-Point Locks.†

Your committee has carefully studied the subject of an improvement in facing-point locks to detect the failure of switch to respond to the movement of the lever, but after exhaustive discussion we are unable to report having conceived anything practical in that line.

The only mechanical device which we consider effective is the so-called bolt lock, which is in reality a detector lock, and should be so named. The bolt lock was designed and employed to detect the failure of switches, derails, movable-point frogs, etc., failing to respond to the movement of the lever, and also to prevent the reversal of such parts until the signal governing them has been restored to the stop position.

Owing to the likelihood of an accident due to a misplaced movable facing point having disastrous results, it is the recognized practice to bolt lock them with the unlimited and limited speed signals governing them as far as practicable. But owing to the complications where a signal is made to govern two or more routes, it is often found impracticable to bolt lock all the movable facing points in each route, and each situation must be considered on its own merits, and the best arrangement of bolt locking determined.

It is not the recognized practice to bolt trailing switches, as the facing-point lock is deemed sufficiently reliable. Should a trailing switch be run through in the wrong position, derailments are not likely to result.

The committee does not consider the safety derived from bolt locking switches leading to high speed routes with slow speed and reverse movement signals, sufficient to warrant the expense and complication which their installation would entail.

When local conditions are such as to render the use of mechanical bolt locking impractical, either switch signal control, or electric locking, or both may be substituted; each situation being considered on its own merits, and the best arrangement determined.

†From the report of the Committee on Signaling and Interlocking.

AN AUTOMOBILE PATROL WAGON for the Police Department of Denver, Colo., is interesting, among other things, because the body of the wagon was built at the city shops. The machinery is of the Stoddard-Dayton type and is of 45 HP. The wagon "will seat eight persons comfortably, and twelve may be crowded into it," according to "Denver Municipal Facts," the new city journal of Denver.

THE MECHANICAL WATER-PURIFICATION PLANT built by the Sewerage and Water Board of New Orleans was put in operation the latter part of February. On March 10, we are informed by Mr. George G. Earl, General Superintendent, about 7,000,000 gals. per day were being supplied to the 485 miles of pipe comprising the new distribution system built by the Board. Temporary connections were being made to the mains of the New Orleans Water-Works Co., pending the laying of service connections to the new mains. Some 12,000,000 to 16,000,000 gals. per day will be required for temporary delivery to the old mains. The filtration plant has a capacity sufficient to supply 50,000,000 gals. per day.

Concrete Fence Posts.*

Concrete fence posts are in use to a limited extent in all fields where wood posts are used. There have been bought for railway use various small orders of concrete fence posts and postmaking machinery and reinforcements. One maker shipped in 1906 two orders for materials for making 1,000 concrete posts each to the Chicago, Burlington & Quincy and Erie railways. It is proposed to order a similar trial shipment for the Michigan Central Ry.

From observation of concrete fence posts, your committee considers that the concrete post will heave very little or not at all, as posts set from two to five years ago are at present in almost perfect alinement, and not a loose or broken post was found. They appear sufficiently strong for all practical purposes, after being properly cured and set. The claim that concrete posts reinforced with steel form lightning protectors appears reasonable. They will, of course, resist the action of fire and decay. They will not float and cannot be displaced so easily as wood posts. On the other hand, concrete posts must be carefully handled in loading and unloading and well cured before using. Fence wire in contact with their surfaces should be well galvanized. The concrete post is much heavier than the wood post and the cost of distributing and setting is about 25% greater.

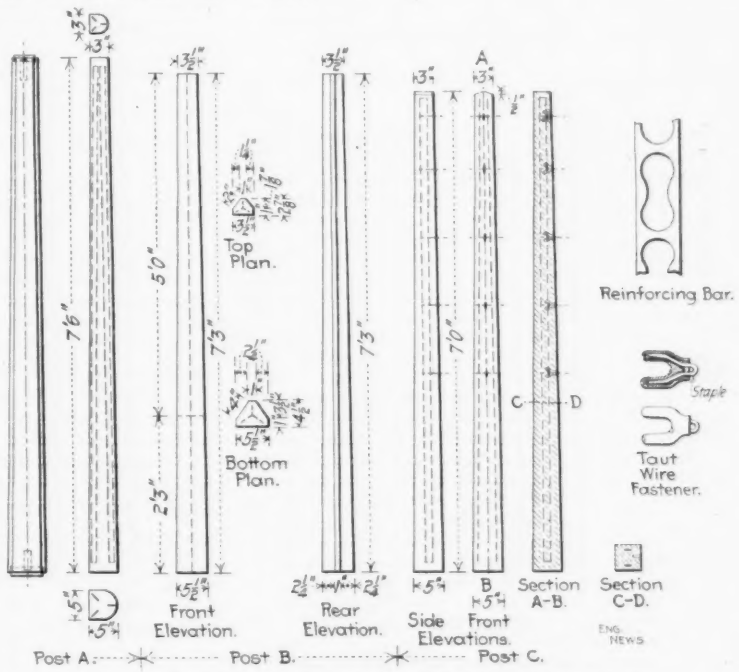


FIG. 1. THREE TYPES OF CONCRETE FENCE POSTS.

It would seem that the concrete post is particularly adapted to railway use. Most of the post machines are cheap and portable and the materials used are in daily use on all roads using concrete; the materials are cheap and easily obtained.

Your committee has corresponded with over 20 manufacturers of posts and postmaking machinery in the United States and Canada. A majority use or advise the use of Portland cement and gravel varying from the size of sand to pebbles which will pass a wire screen having meshes of from ½ to 1-in. sq. The ratio of cement and gravel is 1 to 4. The methods of reinforcing and tamping concrete posts vary almost as much as those of fastening the fence wire to the posts. The machines are of various capacities and design—from the one post hand mold to the "post per minute" power machine with continuous mixer attachment. The average total cubic content of the 7-ft. post is 0.825 cu. ft.; of the 8-ft. post, 0.95 cu. ft. The weights vary from 65 lbs. to 95 lbs., according to methods of manufacture and reinforcement used. Concrete posts retail from 25 cts. to 35 cts. per post. End and gate posts are of about three times the volume and cost of intermediate posts.

In section, concrete posts vary from square or rectangular to triangular, half-round and circular. Reinforcements are of wire, wood, strap steel, steel and wire truss, wood and wire truss, chain scrap strips and expanded metal. Fence wire fastenings are also of various forms—from the wire loop around the post to the patent staple encasement. All the posts observed taper from a smaller top to a larger base. Some have very wide concrete block bases.

In July, 1908, four concrete post machine firms demonstrated their machines at Bay City, Mich., making twelve reinforced concrete posts each, which posts were

*From the report of the Committee on Signs, Fences and Crossings, presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association, held at Chicago, March 16 to 18.

tested at the Michigan Agricultural College at Lansing, Mich. For the purposes of this report, they are designated by letters A, B, C and D.

The cement used was a fine, slow-setting marl cement. The gravel was suitably screened. Although containing some unhardened particles, this is very fair, clean gravel. All competitors used the mixture in the ratio of 1 to 4 of cement and gravel, the water test having shown the theoretical ratio to be 1 to 4:15. Posts A, B and C are shown in Fig. 1.

(A). The post is made on a horizontal steel table the top of which is formed of six to twelve post molds laid side by side, the flanges overlapping. Wet concrete is shoveled into the molds, the tops troweled level and the machine vibrated horizontally until the water shows on the surface, instead of tamping. The molds are removed from the table after the steel strips are inserted in the wet concrete with a holder which places the reinforcement at a certain distance from the concrete surfaces. The fence is fastened by winding a wire around

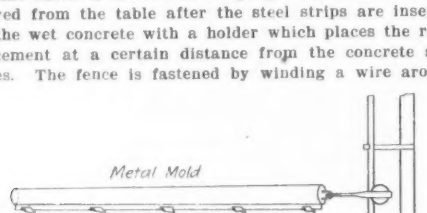


Fig. 2. Traveling Mold for Making Concrete Fence Posts.

the semicircular post. The holding power of this fastening is remarkable. Expanded metal reinforcement bent to a semicircle is also used with this post. It weighs, with strip reinforcement, about 85 lbs.; with expanded metal reinforcement, 89 lbs.

(B). The post is triangular with heavy reinforcement of steel and wire. It is made in a machine carrying two molds which alternately fill from top hoppers out of conveyor buckets filled from a continuous mixer. The machine runs by power and tamps the concrete by striking the base of the mold on a solid bed while holding it in an upright position. Without mixer or engine this machine weighs about a ton, and is claimed to turn out a post per minute. The pallet is of wood and forms one side of the mold. The post when finished is ejected on the pallet over a horizontal roller table. The concrete is made damp and one sack of cement makes 6 posts in 1 to 4 mixture. The posts weigh about 92 lbs. each.

(C). The post is rectangular, made in a horizontal mold by hand and tamped with an iron rod. It lies on a wood pallet which forms the bottom of the mold. A separate casting top holds the post in place on the pallet while the two iron sides are pulled or slid off, the bottom having been removed. The reinforcement is chain scrap, from two to five strips per post being used. The intermediate posts with three reinforcing strips weigh about 105 lbs. The fence wire fasteners are castings which receive and lock the ordinary fence staples. These castings are set into the wet concrete flush with the surface and at desired heights to fit the fence wires.

(D). The post is circular and is made of wet concrete of the consistency of cream poured into the mold or cylindrical flask which hangs vertically, bottom uppermost to a small "traveler." (Fig. 2.) The tamping is done while the mold is being filled by a slight vertical jar obtained by a cam contrivance rotated beneath the hanging mold. The mold is of galvanized iron; springs open when released as does the "A" mold; and has a movable top end piece. The reinforcement (Fig. 3) is a wood core well saturated in water, with four surrounding wire strands extending its full length and forming a truss for which much strength and elasticity are claimed.

The (D) fence wire fastening (Fig. 3) is a strong twisted galvanized wire loop which is a portion of the reinforcement truss, for making which the inventor has a machine. These loops are cut and the ends tacked down over the fence wire. The posts are cured while hanging by the loops of wire which protrude from the bottoms of the posts and which are also parts of the reinforcements. This loop may be used to hold a bar or stick which would tend to prevent heaving when the post is set. Both the (A) and (D) posts have been in use for several years.

These posts were tested in October for tensile strength. Panels were erected to test the holding power of the fence in place as well as give the set posts impact tests and if possible to compare their strength of resistance to impact with wooden posts. They were tested in a machine of large capacity, 42 ins. span, both ends supported, load applied in center. The following results were obtained as an average of seven to twelve posts of each sort so tested:

Name.	First crack.	Maximum wt. post broken.	Deflection in inches.
"D".....	458 lbs.	1,090 lbs.	0.68
"B".....	648 lbs.	1,071 lbs.	0.70
"A".....	564 lbs.	1,020 lbs.	0.53
"C".....	927 lbs.	1,356 lbs.	0.66

It is only fair to mention that the "B" and "D" post machines were operated at considerable disadvantage. The comparative results show the importance of thorough tamping and stiff reinforcement near the surface of the post. A cedar post of dimensions identical with the average of these concrete posts would weigh about ¼ as much and be four times as strong. The results in practice show that the wood posts used are much stronger than necessary rather than that concrete posts are not strong enough.

Tests of Soil for Use in Constructing an Earth Dam for a Water-Works Reservoir, Baltimore, Md.

By EMORY SUDLER.*

The soil tests about to be described were made under the direction of the writer in connection with the preparation of plans for the construction of a 225,000,000-gal. storage reservoir to feed the high-service water-supply district of Baltimore, Md. The reservoir is to be formed by the construction of an earth dam across a valley, and the excavation of about 690,000 cu. yds. of rock and earth from the sides and upper end of the same. The dam is to have a maximum height of 87 ft. above the outer toe, and a total length of about 2,160 ft.; the inside slope is to be 1:3 and the outside slope 1:2½. The materials available for the construction of the dam are a hard serpentine rock overlaid by a soft serpentine or rotten rock, and above this a layer of yellow to brown clay from 2 to 4 ft. thick. The rotten rock and clay were compressed and tested for impermeability, by the method outlined below.

Two pieces of 6-in. wrought-iron pipe were secured, each 4½ ft. long, and each provided with two caps, one containing a hole threaded for a small gage cock, and the other being tapped for ½-in. pipe. The first-mentioned cap being tightly screwed on the pipe, formed the bottom of the experimental tube, on which was placed from 3 to 4 ins. of graded gravel, to provide an outlet to the cock for any water passing through the material to be tested.

The materials were placed in their respective tubes on top of the gravel, in layers measuring about 4 ins. in depth, after leveling and lightly ramming with a stick. Each layer was then subjected to a pressure of from 140 to 160 lbs. per sq. in., the pressure being obtained by means of a plunger operated by an hydraulic jack.

The plunger was made of Georgia pine, turned

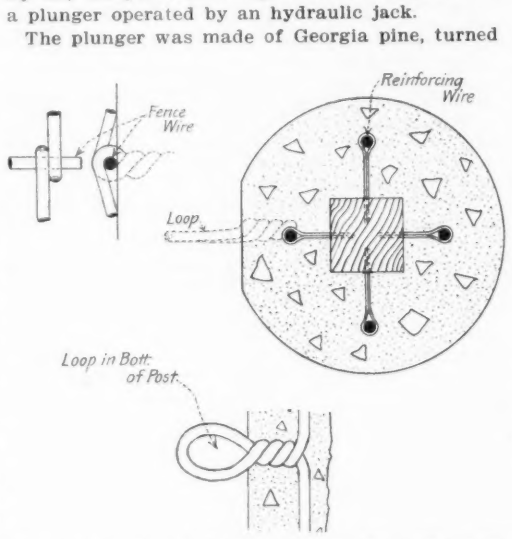


Fig. 3. Section of Concrete Fence Post (Type D), Showing Reinforcement and Fence Wire Attachment.

to a diameter slightly smaller than the inside diameter of the pipe, and about 5 ft. long. An iron band was shrunk around the end which was to receive the thrust of the jack, and the other end was made slightly conical (rise about ¼-in.). A ten-ton jack was used. The cylinder was tapped for a suitable pressure gage, by means of which the pressure applied to the material in the tube could be ascertained at all times.

The filling of the tubes was first undertaken at the site, in the edge of an oak grove, where two trees were found a suitable distance apart to take the thrust of the jack and tube, which were mounted on a 2-in. board, supported between the trees at a convenient height for manipulation. Guide cleats were nailed to the board to keep the tube, plunger and jack in correct alinement, and 1-in., 2-in. and 4-in. blocking was used between the plunger and jack, which was removed as the tube was filled. The weight of a filled tube being from 225 to 230 lbs., a block and fall attached to a limb of one of the trees, was used for handling the tubes between their horizontal position on the board, when using the plunger, and their vertical position on the ground, when placing a layer of material.

Freshly excavated moist material was used in filling the tubes, the only application of water being a light sprinkling of the compressed surface of each layer, just before applying the next. In compressing the layers, the pressure was run up to the desired point and then released, three or four times, the reaction or spring of the compressed material on release being noted each time. The pressure was again run up and held at the desired point for about 15 minutes, before final release.

The total compression averaged about 1 in. for a 4-in. layer and the reaction or spring varied between ⅜-in. after the first compression, and 1/32-in. after the final release.

In order to test the compressed materials for impermeability, it was necessary to transport the filled tubes to one of the city pumping stations. This was not done immediately after they had been filled. When they were finally set up, and a water pressure of 40 lbs. per sq. in. applied, it was plainly evident that between the time of filling and the application of the water pressure (a period of several days), the material had shrunk away from the sides of the tubes. It was then decided to fill the tubes at the pumping stations, so that the pressure might be applied immediately thereafter. This was done, and the compressed materials sustained a water pressure of 40 lbs. per sq. in., during a period of six months.

Immediately after applying the pressure to the rotten rock, water flowed from the cock at the bottom, indicating that it must have passed between the pipe and the rock, notwithstanding the precautions taken to prevent this, but the flow rapidly diminished, and at the end of three months had ceased entirely. At the end of 21 days after applying the pressure to the clay, one drop of water appeared at the outlet cock, and a few drops more showed during the next three weeks, after which, and until the end of the test, the cock was quite dry. On opening the tubes at the end of six months, the material in each was found to be soft for a depth of from 1 to 1½ ins., but below this point was apparently as when put in.

The results obtained from these tests, and from various measurements, are given in the accompanying table.

Both of these materials made a watertight joint with the smooth interior surface of the pipe when kept moist, but in making similar tests in the future, it might be well to swab the interior of the pipe with an asphaltic or heavy oil, just before filling. Even better results might have been obtained, in the matter of compression, had the final pressure on each layer been maintained for a longer period than 15 minutes, thus allowing more time for the escape of entrained air.

The writer noted with some surprise the great frictional resistance developed between the compressed materials and the walls of the tubes, on endeavoring to force some of the clay out of a tube by means of the jack. No measurements of the amount of this resistance were taken.

TABLE SHOWING THE RESULTS OF TESTS OF SOIL FOR USE IN CONSTRUCTING A DAM FOR THE WATER-SUPPLY OF BALTIMORE, MD.

Material.	Volume corresponding to 1 cu. ft. in place. Loose,	Volume corresponding to 1 cu. ft. in place. Compressed, cu. ft.	Weight, in lbs., per cu. ft. when moist. In place, lbs.	Weight, in lbs., per cu. ft. when moist. Loose.	Weight, in lbs., per cu. ft. when moist. Compressed.	Absorption by weight.
Clay	1.5	.86	116	78	131.6	.007
Rock	1.45	.84	108	74.5	129.3	.007

*Assistant Engineer, Water Department, Baltimore, Md.

Railway Freight Yards, Freight Houses and Freight-Handling Machinery.*

In regard to the operation of hump yards, there is a preponderance of opinion in favor of placing track scales on the hump. The location varies from 30 ft. to 300 ft. below the summit. Some advantages of using two scales are pointed out. They enable separate parallel tracks to be built for summer and winter conditions, and also allow the regular work to continue while one of the scales is under repair. But two parallel humps cannot be used at one time in connection with one classification yard, and to provide an additional or alternate hump for use in emergencies entails a loss of room and distortions of lines in both. There is, therefore, a reasonable doubt as to the value of such installations.

At principal gateways of movement, and at points of origin of large volumes of freight of mixed character, and wide distribution the classification should be made: (1) as to fast or slow movement, and (2) as to destination. The question is presented therefore as to the relative merits of the alternative plan of providing a second classification yard with the second hump to be used for fast freight, thus making it possible to take either hump out of service for a limited time without causing complete stoppage of classification, and making it possible to nearly double the classification capacity with a comparatively small increase in facilities. The second hump might be parallel with or tandem with the first, according to local conditions.

The relation of the percentage or proportion of cars to be weighed to the location of scales on the hump or elsewhere is not yet determined. We have testimony to the effect that the scale should not be located on the hump unless about 25% of the cars to be handled must be weighed. We also have the opinions of men who are in charge of large hump yards that handle thousands of cars daily, that the scale should be located on the hump regardless of the number or proportion of cars to be weighed. We assume therefore that the greatest economy would be secured by locating the scale on the hump if it is assured that from 5 to 10% of the cars must be weighed.

The question of loss of efficiency on account of the presence of a scale on a properly designed hump need not trouble us at present, and we need not begin to consider it until we can reasonably anticipate a possible movement in one direction exceeding 5,000 cars to be weighed and classified in 24 hours. It is believed that long before that time we will be using two separate yards, each with its hump and scale, one to be used for fast and the other for slow freight. This will overcome the trouble anticipated from overcrowding, but in another and better way, and still retaining the scale on the main hump track to be used whenever and to whatever extent it may be needed and without material loss of time or efficiency of the hump.

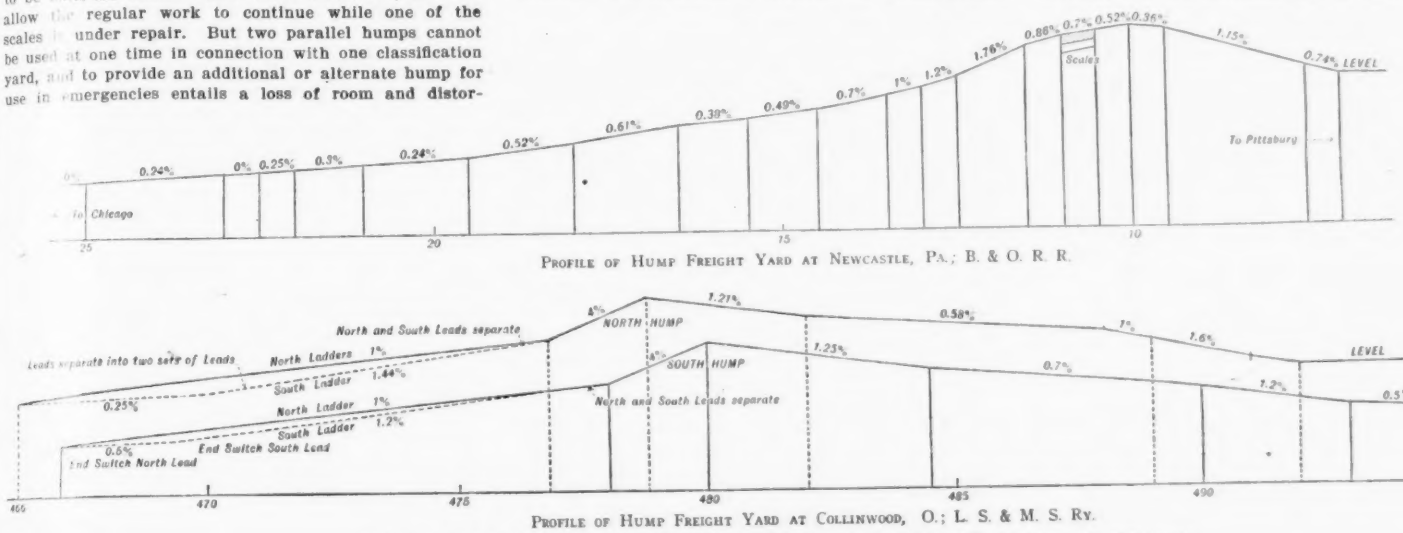
We do not need to omit scales from humps on account of loss of efficiency caused by their installation, but we do need generally better yard design, steeper grades between the summit of humps and the receiving ends of the classification tracks, and better facilities for the return of car riders. (Figs. 1 and 2 show the grades adopted for some recent hump switching yards).

In hump yards in which the approach grade to the hump is heavy, the cost of operation is excessive, due to the large amount of power required. In some cases, very large engines are used, or two engines are used. In many cases, trains hauled into the yard by one engine are cut into two or more sections to be pushed over the hump. In some cases the lack of room has caused heavy grades approaching a hump, with consequent increase in cost of operation, and in many places where lack of room has prevented gravity classification, it could be successfully employed if the cars could be handled promptly on approach grades that are too heavy for operation by locomotives.

*Abstract of the report of the Committee on Yards and Terminals, presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association, at Chicago, March 16 to 18, 1909.

We present therefore as a suggestion the plans of works that have been in successful operation for many years in Pennsylvania for operating freight traffic over short routes with inclined planes (by cable) instead of over long routes with ordinary grades by locomotives. These works are still used extensively, notwithstanding the fact that much time and study have been devoted to the problem of devising cheaper and more satisfactory methods. The operation is generally on double tracks, the cars being hauled up by a wire cable first on one track and then on the other. In some cases empty cars are lowered as a partial counterpoise, thereby making it possible to increase the load to that extent.

It is thought that where more than one engine is required to push a train over the hump, or where the approach grades are too steep to be operated successfully or economically by locomotives, the question of substituting stationary power is worthy of consideration.



PROFILE OF HUMP FREIGHT YARD AT NEWCASTLE, PA.; B. & O. R. R.

PROFILE OF HUMP FREIGHT YARD AT COLLINWOOD, O.; L. S. & M. S. RY.

FIG. 1. PROFILES OF SWITCHING TRACKS IN YARDS FOR HUMP SWITCHING.

Terminal Freight Houses.

The arrangement of the combined terminal freight station and warehouse of the Wabash-Pittsburg Terminal Ry. is shown in Fig. 3. It is a four-story steel building about 60 ft. in width, with the team delivery on the first floor, and the tracks at the fourth floor level (about 60 ft. above the street). There are three tracks on one side and two tracks on the other side. The intermediate floors are used for storage and private warehouse purposes. The building has one 10-ton and five 5-ton plunger elevators. Freight from the cars is loaded upon three-winged trucks. Four or five of these trucks are run upon an elevator and carried to the intermediate floors for storage, or to the bottom floor for delivery to wagons. Freight received by wagons is disposed of in the same way for delivery to storage or to cars. Thus intermediate handling of the freight is avoided. None of the cross streets are interfered with by this building, the freight house (or first floor portion) being interrupted to let the streets pass through.

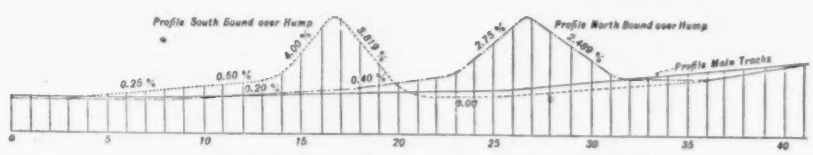
At important points and large cities there is an increasing use of terminal freight stations having upper floors for warehouse and storage purposes.* These are for handling freight in less-than-carload lots. Team tracks for car-load freight may then be provided on the surface in the manufacturing districts rather than in the business centers, where package freight is usually handled. This arrangement for such localities may, as a rule, give material economic advantages over the ordinary one-story building. In the latter it is difficult to avoid an excessive amount of trucking over long horizontal distances. But with a building having upper floors, much of the movement must be effected by elevators, and the movement can be effected rapidly and economically by means of an ample number of elevators.

A two-story freight transfer house might be found economical in certain cases, owing to the use of elevators and the saving in ground area. All freight to be transferred would be elevated and then trucked over an unobstructed floor to the elevators feeding the cars into which the freight is to be placed.

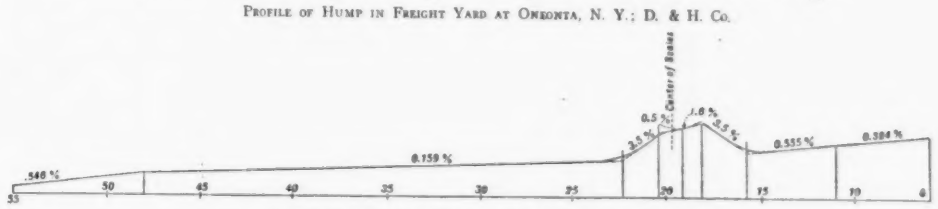
The one-story terminal freight house is the type in most general use, and some modern arrangements are illustrated. Fig. 4 shows the cross-section of the terminal freight house of the Missouri Pacific Ry. at the State Line Yards in Kansas City. There is one trucking platform, with three tracks between this and the inbound house, and four tracks between it and the outbound house. The general plan of the Pennsylvania Lines freight house at Indianapolis, Ind., is shown in Fig. 5. In this case the freight house is across the ends of the tracks instead of being parallel with the tracks. The tracks are in pairs, alternating with platforms, and have curves of 100 ft. radius. The length of the tracks is from 190 ft. to 270 ft., with capacity of from four to seven cars. The total length is 3,280 ft., and total capacity, 78 cars.

The new freight terminal of the Lake Shore & Michigan Southern Ry. at Toledo, Ohio, is shown in Fig. 6. The single tracks alternate with 14-ft. covered platforms 12 ft apart in the clear. There is no platform between the outbound house and the track, but a 10-ft. platform is placed between the inbound house and track.

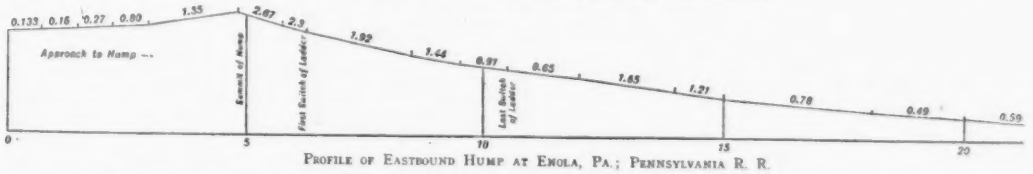
*Engineering News, March 26, 1908.



PROFILE OF HUMP IN FREIGHT YARD AT ONEONTA, N. Y.; D. & H. CO.



PROFILE OF HUMP OF YARD AT TERRE HAUTE, IND.; VANDALIA RY.



PROFILE OF EASTBOUND HUMP AT ENOLA, PA.; PENNSYLVANIA R. R.

FIG. 2. PROFILES OF SWITCHING TRACKS IN YARDS FOR HUMP SWITCHING.

Freight Handling and Conveying Machinery.

There appear to be no conveyor systems in use in ordinary freight houses. Inquiries sent to a large number of manufacturers of machinery of this kind have failed to bring to light a single installation, although several state that their machinery is applicable to the

service. In a few cases, conveyors are used for loading and unloading cars at industrial establishments and at steamship piers.*

For handling heavy or bulky freight at yards, cranes are very generally used. These may be fixed jib cranes,

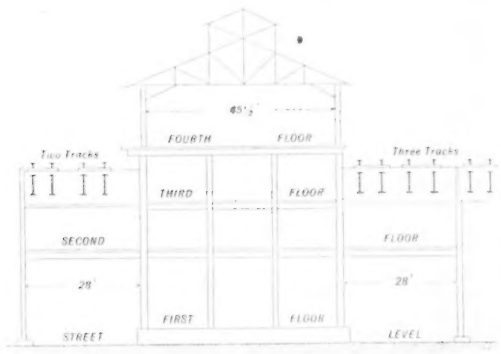


Fig. 3. Cross Section of Four-Story Freight Station and Warehouse at Pittsburg, Pa.; Wabash-Pittsburg Terminal Ry.

or overhead cranes of different classes. The latter usually span one or more tracks and a driveway, so as to transfer the articles between cars and wagons. These may be classed as follows, the bridge in each case carrying a trolley hoist which travels upon it: (1) the bridge fixed; (2) the bridge traveling on an elevated runway; (3) the bridge carried by towers which travel on surface tracks.

For handling freight in a warehouse, pier shed or freight house, the following systems may be used: (1) Conveyors (roller, chain, belt, platform, etc.); (2) overhead traveling crane; (3) carrier systems. Freight handling by machinery may be divided into two classes (A) in warehouses and steamship piers, where the movement is mainly longitudinal. (B) in freight houses, where there are numerous movements in different directions. The former case is much the simpler, but it may be found practicable to introduce mechanical handling, so as to reduce the amount of trucking in the latter case. The Committee calls attention to the opinions quoted below: [We quote only two of these.—Ed.]

PENNSYLVANIA LINES.—The Pennsylvania System has, so far as I know, no machinery whatever at freight warehouses for the purpose of handling freight from and to platforms, in or out of cars, nor for the purpose of transferring between cars. We have a few city warehouses of double-deck design, where the freight is transferred between the truck and car platforms by means of elevators.

There is, in my judgment, a wide field for improvement in the railway's method of handling freight to and from cars, and I believe that a great deal of money could be saved by properly equipping some of the larger freight warehouses with suitable devices for handling freight. This particular feature of our business has been neglected, and I think you would be doing a good work in calling the attention of the railways to that fact. Many manufacturing plants whose business is small compared with one of our large freight warehouses, are far ahead of us in the use of labor-saving machinery for transporting material (A. B. Starr, General Superintendent of Freight Transportation).

WABASH RY.—About a year ago I endeavored to make a study of this question with a view to adopting some method of mechanical handling of merchandise freight at some of our most important freight stations. The need of mechanical appliances in this connection is much greater in connection with a large inbound freight house than it is in a modern outbound house, where the arrangements are usually such that the trucking of freight is reduced to a minimum. I confined my attention, therefore, to the question of the inbound house.

There seem to be two or three main points to be considered: (1) The utilization of every possible square foot of floor space for storage purposes. (2) The transportation of the freight from any point in the house to any other point in the house (including, if you please, delivery on wagons standing at the doors) by mechanical means with the greatest amount of rapidity and the least possible interference with other operations that might be going on within the house simultaneously. (3) The problem of handling in this manner miscellaneous packages of all sizes, shapes and weights.

I consulted a good many manufacturers, engineers and a number of freight house employees who were thoroughly familiar with the practical everyday workings of the business. I came to the conclusion that to meet all of the requirements, there was only one machine that could be favorably used, namely, an electric traveling crane, supplemented, perhaps, by two trolley hoists operating for the full length of the house, one on each side, and depending upon the design of the house itself, whether they operate immediately inside the walls or immediately outside the walls.

The methods which seemed most practical for the handling of small package freight, was by means of stoutly constructed platforms of convenient size, having chains attached to the four corners, which could be swung from the hook of the crane. Several of these could be placed conveniently near the door where a car was being unloaded and the freight deposited directly upon them by men who were breaking out the car. They could then be handled either by the trolley hoist or the traveling crane, or both, and set down at any spot in the freight house where it might be desired to place them for storage, or placed directly on the wagon waiting to receive them, platform and all. The size of the platform could be made to conform as nearly as practicable to the average size of the ordinary freight transfer truck or wagon.

The problem had some very important limitations and restrictions, on account of our being obliged to apply it to a building originally designed with no idea of anything of this nature. I believe it would not be difficult to design a new freight house to allow for the mechanical handling of freight along the lines indicated above, and doing it with rapidity and economy of operation which would reduce by at least 50%, and probably more, the expense that is now incurred in the ordinary inbound house, where the freight is handled entirely by hand. Of course, this same idea could be enlarged and elaborated upon in connection with combined freight and storage houses, where it is desirable to utilize two or three floors of the building.

So far as I can see, this plan seems to be the most feasible of any that have been suggested up to the present time for the handling of miscellaneous package freight in an inbound freight house (Geo. G. Yeomans, Assistant to the President).

Cranes are used in some warehouses, but as a rule the height of the ordinary freight house is not sufficient to permit the use of an overhead traveling crane. A railway warehouse in Scotland has revolving cranes (with horizontal booms) suspended from runways. These give greater flexibility and capacity than an overhead traveling crane with hoisting trolley.

Traveling hoist installations have been planned. One manufacturer states that he has figured on several such installations, but that with enough trackage to cover the floors satisfactorily the cost is so high that the proposition is usually dropped. In some of these systems there is a "herringbone" arrangement; the main runway extends through the central bay of the building. On this travels a bridge for the hoist. At intervals there are branch runways at right angles to the main runway. The bridge can be stopped in line with any one of these

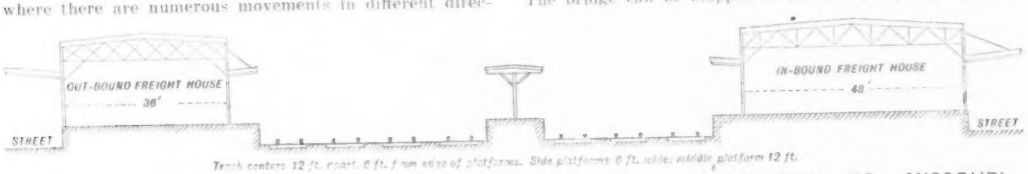

OUT-BOUND FREIGHT HOUSE
36'
STREET
IN-BOUND FREIGHT HOUSE
48'
STREET
Track centers 12 ft. apart, 8 ft. from edge of platforms. Side platforms 6 ft. wide; middle platform 12 ft.

FIG. 4. CROSS SECTION OF TERMINAL FREIGHT STATION AT KANSAS CITY, MO.; MISSOURI PACIFIC RY.

and the trolley hoist run out on the spur. In the telpherage system, the trolley hoist handles wheeled platforms or trucks. This is to be used at Baltimore by the Baltimore & Ohio Ry.

Gravity conveyors include inclines and spiral chutes. The former are used in several industrial plants. The floor is composed of rollers. One form has a spiral platform in the annular space between two steel cylinders extending from top to bottom of the warehouse. Other systems have an open spiral trough, or a spiral frame carrying a floor of rollers.

At the Minnesota Transfer, near St. Paul, about 1,700 ft. of a portable gravity conveyor system* is used for unloading shingles and lumber from railway cars, and distributing them through the yard and warehouse. There are two parallel rows of small wheels or rollers forming the conveyor, and their frames are supported at intervals by light steel cross frames or bents. The grades may be from 3 to 4%. The Virginia Steel Dock & Warehouse Co., of Seattle, uses the same system for carrying packages from steamers into the warehouse and from the warehouse to cars and local steamers. A similar system,† but with rollers forming the floor, is used at some of the shipping stations of the Anheuser-Busch Brewing Association.

Various systems of belt, roller, chain and platform conveyors are in extensive use in industrial establishments and warehouses. In many cases they are operated in connection with elevators and inclines for raising and lowering the packages.

The general opinion seems to be that there is no machinery or conveyor equipment that can successfully handle freight in ordinary freight houses, and that it would be difficult to devise a satisfactory equipment for such service. The special difficulties are: (1) the great variety in shape, size and weight of the packages; (2) the fact that packages delivered by teams at the various doors have to be distributed to cars at various points on the other side of the house. Ordinary conveyors are not adapted to this service, being most suitable for carrying packages between fixed points of receipt and delivery.

Two possible methods of handling freight between variable points are movable platforms for the packages, or means of moving the trucks by mechanical power so as to reduce the time and labor involved in moving them by hand over long distances. A traveling platform level with the floor has been devised, moving at slow speed, so that men, trucks and teams can cross it. In a plan proposed for an inbound freight house of the Baltimore & Ohio Ry., the moving platform would form a belt line; one side would be near the track side and the other near the team delivery side. Packages (or trucks) from the cars would be dropped on the moving platform. The house would be divided into sections, with a man to each, and each man would pull off the platform the freight for his section as it passed him.

In another system, the platform would be a single line only, the return side being underground. This was designed more particularly for steamer piers, where freight delivered at the end or from a steamer has to be transferred for a considerable part of the length of the pier.* For handling trucks of freight, the committee presents information as to two systems: (1) A telpherage or overhead runway system; (2) an underground cable system.

1. OVERHEAD RUNWAY SYSTEM.—The Dodge telpherage system is in use at a steamship pier, and is to be introduced by the Baltimore & Ohio Ry.† A pair of trolleys riding on an elevated runway carry a frame with hoists for raising and lowering trucks of wheeled platforms. Current for electric traction is taken from an overhead wire, and an attendant riding with the machine controls the traveling and hoisting movements. This system has been in operation for about four years on the pier of the Old Dominion Steamship Co., at Richmond, Va. It handles 3-ton loads between the wharf and the railway warehouse and cars. It is said to show a great saving in cost over the old hand-truck method, besides being able to handle freight more rapidly and with much greater ease.

A telpherage installation designed for the Bergen (N. J.) freight house of the Erie Ry. is shown in Fig. 7. There are three platforms, each 1,400 ft. long, and three telpher tracks (one over the center of each platform) connected by loops at the ends. Ten telpher machines operating at one time on the three tracks, all machines following each other in the same direction around the loop, as shown by arrows, would provide for a movement of 1,000 tons of freight per day of 20 hours. Each machine was required to make one round trip of 3,000 ft. in six minutes (at the rate of 10 trips per hour). The average speed would therefore be 500 ft. per minute, including all stops and slow-downs, and the maximum speed of traveling will be 1,500 ft. per minute. The telpher carrier is shown in Fig. 8.

The cycle of operations is as follows: Each telpher

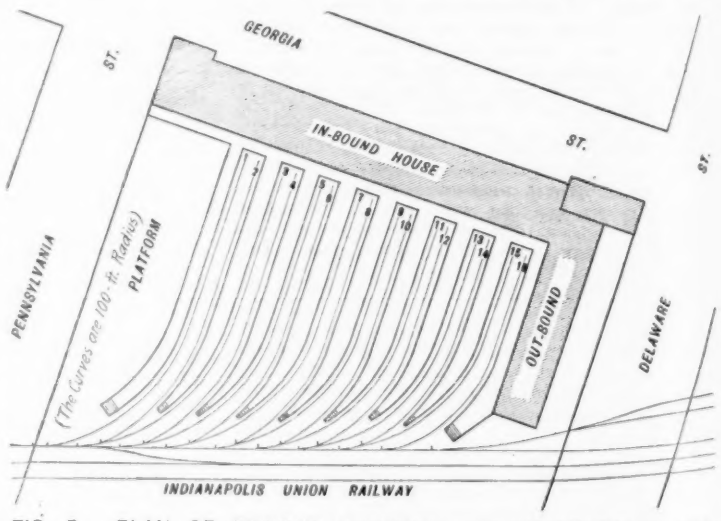


FIG. 5. PLAN OF FREIGHT TERMINAL AT INDIANAPOLIS, IND.; PENNSYLVANIA LINES.

passing along telpher track "A" stops over a loaded truck, which has been placed directly beneath the telpher runway. The operator lowers the bail, engaging the hooks with the ends of the carrier, and hoists the load (maximum distance 15 ft.). The telpher then runs in

*Engineering News, March 23, 1905.

*Matthews Gravity Carrier Co., St. Paul, Minn.
†Alvey-Ferguson Co., Louisville, Ky.

*Spence Mfg. Co., St. Paul, Minn.
†J. M. Dodge Co., Philadelphia, Pa.

the direction of the arrow, and takes either track "B" or "C," as required, and stops at some designated point, lowers the truck, which automatically disengages itself from the bail on touching the floor. The telpher then continues and picks up an empty truck (in waiting directly beneath the telpher runway) and returns to track "A." It lowers the empty carrier and proceeds to the next loaded one, thereby completing its cycle.

The cost of handling freight in the above manner has been figured at 5 cts. per ton. This is based on carrying an average load of only 1,000 lbs. at each trip, although the machines were to have a maximum capacity of 2,000 lbs., which seemed to be sufficient to handle the bulk of the freight. This cost per ton is also based on electric power supplied at 4 cts. per KW.-hr., and a telpher rider at 20 cts. per hour. This does not include the labor for loading the freight onto the trucks and placing them beneath the telpher runway, nor for unloading the trucks and replacing them under the runway. The figures given above are those of the manufacturers of this system.

The Memphis Warehouse Co. has overhead trolley tracks (Breck system) for handling cotton. The trolleys are not motor-driven, however, but the tracks have a slight grade so that the load moves by gravity. The grade begins at the beginning of the inbound platform and extends through the plant to the end of the outbound platform, a distance of about 1¼ miles. The arrangement permits of placing four (or even six) trains of 25 cars each at the inbound platforms at one time, without "spotting." This makes it possible for one switching engine and crew to do the work, while ordinarily three or four engines would be required. There are about three miles of the trolley runway and six miles of railway tracks. The cost of handling by the telpherage system is said to be only about 12½% of the cost of teaming. The company has an extensive cotton warehouse and compress plant, with storage capacity under cover for about 125,000 bales.

(2) UNDERGROUND CHAIN SYSTEM.—A system of handling freight trucks by a traveling chain has been patented by a firm of conveyor manufacturers,* and is intended to reduce the labor of the trucking in a longitudinal direction. The idea was to devise a system that would provide for taking freight from any car along the platform and delivering it to any other car as conditions require. In order to accomplish this, it was found desirable to use the ordinary hand-truck, with slight modifications, so that it can readily be wheeled around from one place to another by manual labor when desired. The truck travels upon a narrow-gage track, and is provided with special attachments to engage an endless chain set underneath the track. This driving chain lies entirely beneath the floor, and is out of the way. As there is only a groove 1 in. wide in the floor, there is no danger of accidents, and the floor is left entirely clear to truck across or walk upon at any time.

*Alvey-Ferguson Co., Louisville, Ky.

An interlocking roller chain is provided for the purpose of giving motion to the trucks. This chain is provided at regular intervals with a lug, which is arranged to engage with a swinging lug which is attached to the axle of the truck. This engagement takes place the moment that a truck is set level upon the track, and immediately propels the truck forward at a uniform speed. The trucks are released from engagement immediately after they are raised from the track, or switched off the main track, so that there is no time lost in engaging or disengaging the trucks. The track consists of a flat steel rail, set flush with the floor.

It is practicable to place switches at each car, so that a truck may be switched directly from the conveyor into the car door. These switches may be set at whatever intervals conditions require, and may all be controlled from a central point, so that trucks may be automatically carried from one car to any other. When a loaded truck is delivered at the car door it can then be picked up and wheeled by hand through one car into another or back to the end of the car for storing this load. When the truck is empty, it is only necessary to push it out of the car door to edge of platform, where it is taken up by the conveyor and delivered to its desired destination for another load.

Fig. 9 is a general plan of the arrangement and Fig. 10 shows the details. This conveyor arrangement can be adapted to operate through two or more floors where necessary, as the design includes provision for a means of automatically elevating the trucks from one floor to another. The trucks can be moved in various directions, as conditions may require.

The quantity of freight moved will depend upon the speed of the conveyor and the number of trucks used. It is proposed to run it at 60 ft. per minute, providing one truck for each 12 ft. of conveyor. The trucks are estimated to carry 1,000 lbs. each. On an average, this would be 5,000 lbs. of freight per minute, or 300,000 lbs. per hour, making a total for ten hours' work of 1,500 tons. This would probably answer the requirements of most railway transfer houses, or at least of the number of cars which could be located alongside of one transfer platform. If greater capacity should be required, the size of trucks could be increased, as could also the speed of conveyor.

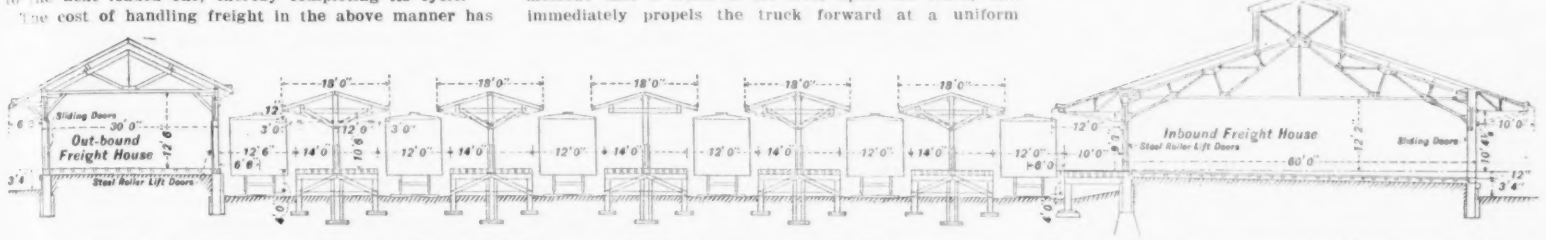


FIG. 6. CROSS SECTION OF NEW TERMINAL FREIGHT STATION AT TOLEDO, O.; LAKE SHORE & MICHIGAN SOUTHERN RY.

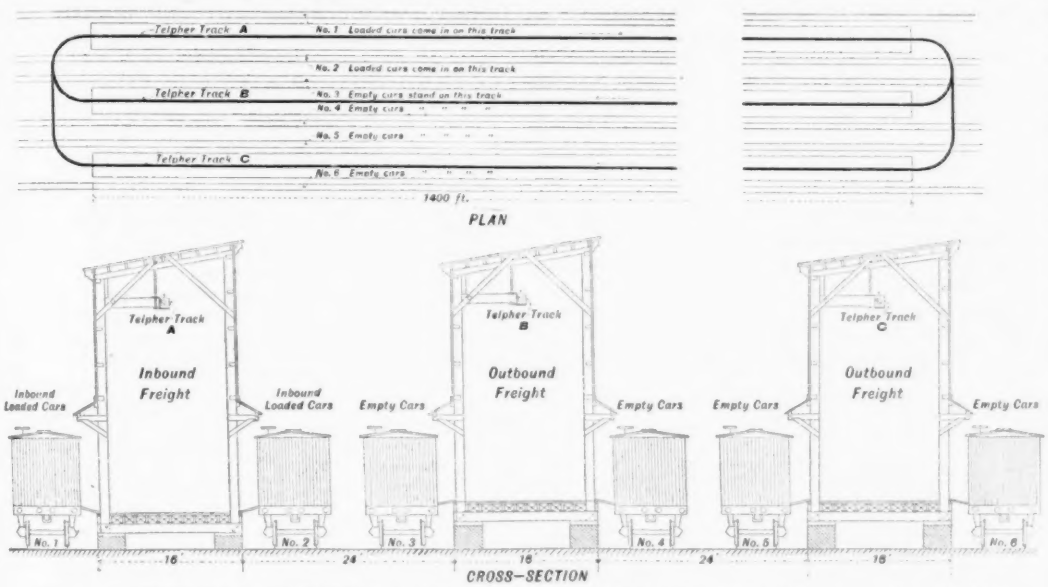


FIG. 7. PROPOSED TELPHERAGE SYSTEM FOR HANDLING FREIGHT AT A FREIGHT HOUSE; ERIE RY.

(J. M. Dodge Co., Philadelphia, Pa.)

GIANT SPRINGS, NEAR GREAT FALLS, MONTANA.—Near the Great Falls of the Missouri in north-central Montana are some very large springs that present certain unique geologic features and suggest an interesting problem as to the source of the water. These springs, known locally as Giant Springs, were discovered in 1804 by Captain Lewis, of the Lewis and Clark expedition, who described them as the "largest fountain in the United States."

These springs, which are on the south side of Missouri River, about 3 miles below the town of Great Falls, Mont., issue through large joints in a medium to coarse grained sandstone on the bank of the river at the water's edge and in the bed of the river itself. The situation of the springs makes exact measurement of their flow very difficult, but the difference between two measurements of the flow of the Missouri—one above and the other below the springs—has been assumed to be the quantity of water furnished to the river by the springs. According to E. T. Nettleton, this amount is approximately 638 cu. ft. a sec.—the equivalent of more than 400,000,000 gals. every 24 hrs.—a veritable underground river. The water, which boils up with considerable force, is clear and relatively pure, containing no more dissolved salts than the average well water of the Great Falls region. It has a temperature of about 50° F.

In connection with an investigation of the geology and water resources of the Great Falls region, C. A. Fisher, of the United States Geological Survey, made a careful study of the geologic relations at the springs, from which he concluded that their water is derived from the subriver flow of the Missouri that leaves its valley near the mouth of Sand Coulee and passes down a channel that was occupied by the river in preglacial time. From Gibson Flat, an oxbow of this old river channel, the water makes its escape by a subterranean passage through porous sandstones and sandy shales to the present Missouri River, where it appears in Giant Springs. Mr. Fisher believes that the jointing in these rocks is an important factor in the underground movement of the water and states that well borings in lower Sand Coule and Gibson Flat demonstrate that the materials filling the old valley are largely coarse river sediments well adapted for the rapid percolation of water.

No use is made of the water of the Giant Springs.

Mr. Fisher's report on the water resources of the Great Falls region has been published by the Geological Survey as Water-Supply Paper 221, copies of which may be obtained free of charge by applying to the Director of the Survey at Washington, D. C.—"Press Bulletin," U. S. Geological Survey.

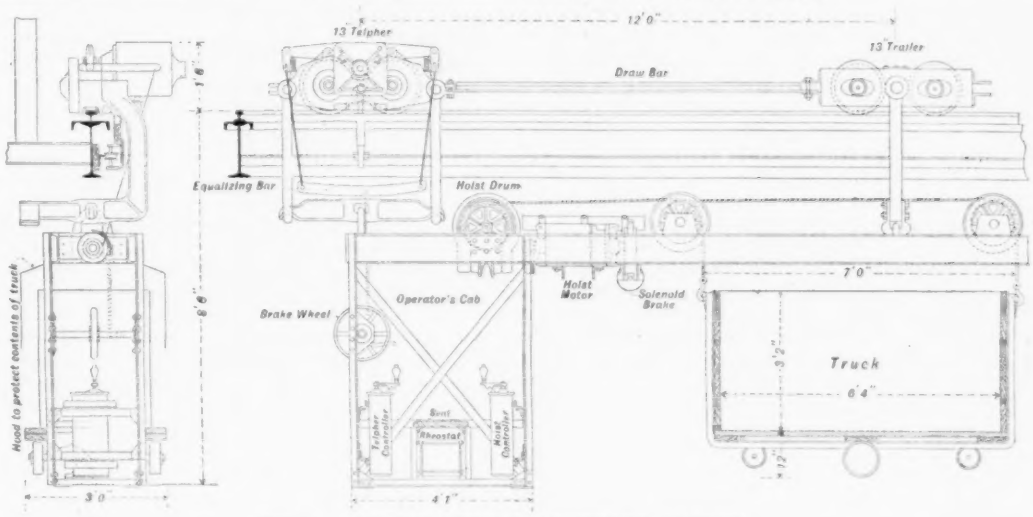


FIG. 8. CARRIER FOR TELPHERAGE SYSTEM.

The Relations of Irrigation to Navigation.

By F. W. HANNA.*

The irrigation canals in the United States have thus far been but little used for navigation purposes. There are several reasons for this lack of common use of the canals. Most all of the irrigation canals of the United States are located in regions remote from the seashore. The streams

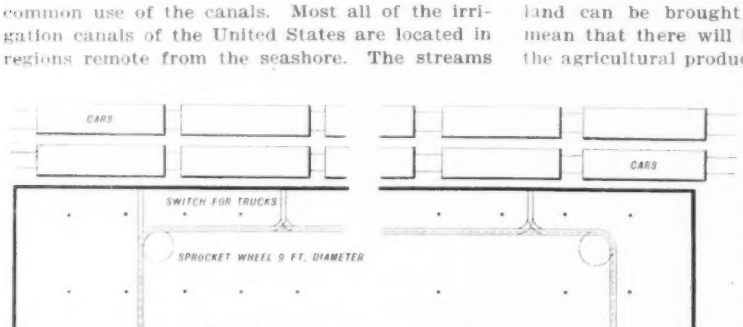


FIG. 9. PLAN OF TRAVELING CHAIN SYSTEM FOR HANDLING FREIGHT TRUCKS.

(Alvey-Ferguson Co., Louisville, Ky.)

in these regions are shallow, abound in numerous falls and usually have steep gradients. The streams, therefore, from which the canals have their sources, are not utilizable for navigation purposes, and therefore it becomes impracticable to use the canals themselves for this purpose. In order to be of general use for navigation purposes, an irrigation canal should be perennial in flow, and this is rarely the case with most of such canals. The great stretches of sparsely settled territory surrounding the various irrigation projects also has a debarring influence on the use of canals for navigation purposes. The combination of navigation with irrigation uses of canals greatly increases the cost of construction of the waterway through the necessity of locks, parallel channels, bridges of great headway or capable of turning, expensive aqueducts and other structures. There is, therefore, but little chance that the irrigation canals of the arid regions of the United States will ever be used for navigation purposes.

The principal relation that irrigation will ever bear to navigation on account of the waters themselves, must necessarily be through the storage of waters supplying the irrigation canals. The construction of large storage reservoirs on the headwaters of rivers in the arid regions will, undoubtedly, have some beneficial influence on the streams draining the territory in which the storage reservoirs are located. The storage reservoirs will reduce the heights of floods, thereby making the matter of channel maintenance easier and preventing injury to the wharves accommodating boats on navigable streams. The remoteness, however, of the storage reservoirs from the navigable portions of the rivers on which they are located will greatly minimize this influence. The storage of water for irrigation will largely take place during the seasons of the year when there is an abundance of water in the rivers, and this water will be released at those seasons of the year when there is the least amount of water in the rivers. In this way, the storage of water for irrigation purposes will increase slightly the minimum flow of the streams. This increase is less than the real storage capacity would indicate, because the stored water is diverted onto the lands that are to be irrigated and is thereby partially dissipated through evaporation and the transpiration of the growing vegetation.

There is, however, one beneficial influence that irrigation must always have on navigation. This is an influence on traffic by increasing the amount of production of agricultural products. There is estimated to be in the neighborhood of 60,000,000 acres of feasibly irrigable land in the United States, a territory nearly equal in area to the combined areas of Iowa and Illinois. If this land can be brought under cultivation, it will mean that there will be a very large increase in the agricultural products of the country, and necessarily, therefore, an increasing demand for transportation facilities. Inasmuch as the railroads at the present time are inadequate for the transportation of the products of the country, and are likely in the future to become more so, greater use must be made of navigable channels for this purpose.

In many foreign countries, particularly in Egypt, Italy and India, irrigation canals are extensively used for navigation. The conditions in these countries are, however, very different from those in the arid regions of the West. The irrigable lands are more accessible to the high seas, are more concentrated and are densely populated, all of which favors navigation of irrigation canals and, therefore, navigation in general.

In Egypt, the entire irrigable area lies within the valley of the Nile River, and is situated nowhere at any great distance from the river. Throughout the major portion of the year, the river is navigable from its mouths to Assuan. The Nile is particularly adapted to navigation, as the prevailing wind is up-stream, thus aiding the travel of boats in that direction, whereas the velocity of the stream, which, although sufficiently moderate not to offer a serious obstacle to navigation up-stream, assists it down-stream. Many of the large canals having their sources in the river are equipped for navigation by small crafts, thus enabling freight to be carried to and from the irrigable lands. Nearly all the cotton of Egypt is grown along these navigable canals and the irrigation pumping plants requiring coal in large quantities are also located on them.

In spite of this fact, navigation of the Nile has had but little friendly help except that given to it through the irrigation department of the Egyptian government. The government has otherwise discouraged navigation of the river for the purpose of assisting the railroads, which are practically a government monopoly. In northern Italy, the irrigation canals have their headings in tributaries of the Po River, and are therefore connected more or less with the traffic of that stream. The irrigated territory is also connected with the Adriatic Sea, which also stimulates navigation.

In India the canals that are used both for irrigation and navigation purposes are situated comparatively near the seashore. The canals on the lower Ganges and Jumna rivers and those on the Indus are favorably located for navigation because of the dense population in their vicinity and because of their navigable connections with the sea.

Our country finds a close parallel to the conditions of these countries in the Sacramento, San Joaquin and Columbia rivers on the Pacific coast. When irrigation is adequately developed in the valleys of these streams, navigation can be made to play an important part in the handling of the commerce produced thereby. The great Missouri could also be made to serve a close and beneficial use for the irrigation developments in its immediate valley in the Dakotas and eastern Montana.

The lack of universal relation between irrigation and navigation should not be construed into a minimization of the importance of either of these great undertakings. Either of them is amply able to stand on its own merits. Certainly there is nothing of greater national importance in the conservation and utilization of the great resources of nature than the development of our lands, arid and swamp, and of our waterways.

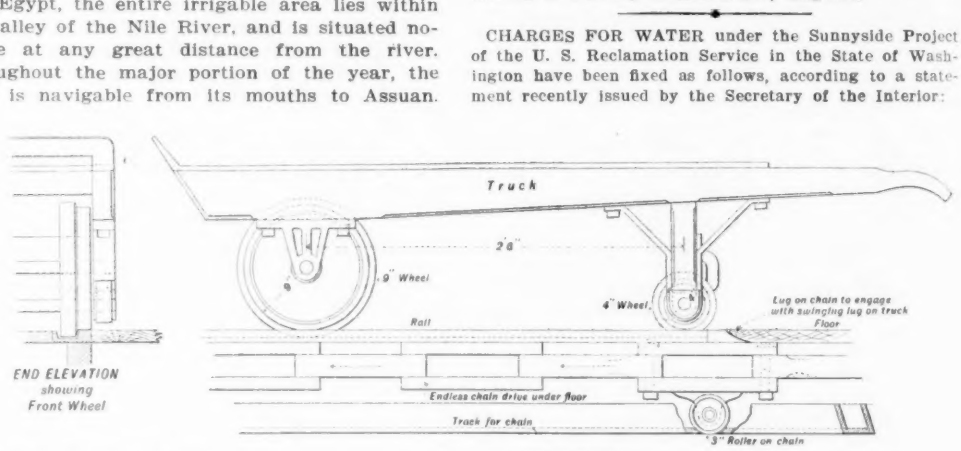


FIG. 10. TRUCK FOR TRAVELING CHAIN SYSTEM.

A REFUSE DESTRUCTOR FOR ROTTERDAM, Holland, with a capacity of 450 long tons per day, is to be built. There will be 40 cells, with an equipment of boilers, regenerators, fans, and provision for mechanical handling. The installation will cost about £130,000 or $630,000. The contract has been awarded to Messrs. Heenan & Froude, of Manchester, England.

CHARGES FOR WATER under the Sunnyside Project of the U. S. Reclamation Service in the State of Washington have been fixed as follows, according to a statement recently issued by the Secretary of the Interior:

The charges which shall be made per acre of irrigable land which can be irrigated by the waters from said irrigation projects are in two parts, as follows:

(1) The building of the irrigation system, $52 per acre of irrigable land, payable in not more than ten annual instalments, each payment not less than $5.20 per acre or some multiple thereof, provided, however, that full payment may be made at any time of any balance remaining due, after certification has been made by the Commissioner of the General Land Office that full and satisfactory compliance has been shown with all the requirements of the law as to residence, cultivation and reclamation.

(2) For operation and maintenance, which will, as soon as the data are available, be fixed in proportion to the amount of water used, with a minimum charge per acre of irrigable land whether water is used thereon or not. The operation and maintenance charge for the irrigation season of 1909, and until further notice, will be 95 cts. per acre of irrigable land for which water is ready in the irrigation season of 1909, whether water is used thereon or not.

*Engineer, U. S. Reclamation Service, Boise, Idaho.

A Reinforced-Concrete Pressure Sedimentation Tank.

By HAROLD D. ELFRETH.*

The recently erected filter plant for the Champlain Silk Mills, at Whitehall, N. Y., contains the only reinforced-concrete, pressure sedimentation tank yet built, so far as the author's knowledge goes. These mills get their water from a river which just at present is very muddy owing to the dredging operations being carried on thereabouts for the New York State Barge Canal, so that it became necessary to provide for the removal of the denser material from the water before it entered the mechanical filtration plant which had been designed. When the dredging work is completed the sedimentation tank may be removed from the system, though it was designed for permanent use.

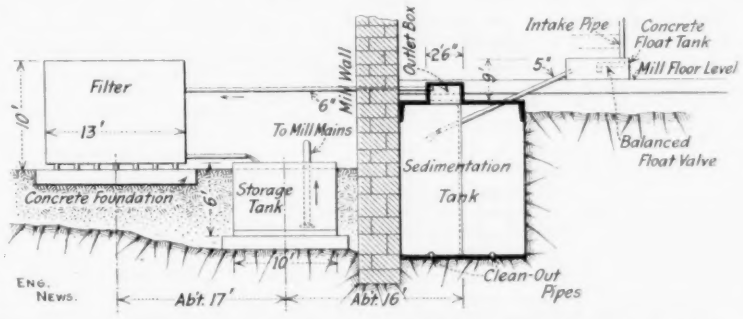


FIG. 1. DIAGRAMMATIC SECTION THROUGH WATER FILTRATION AND SEDIMENTATION PLANT; CHAMPLAIN SILK MILLS, WHITEHALL, N. Y.

The general operation of the plant, which is built underground, for the most part under one of the mill buildings, is best understood from the diagrammatic section in Fig. 1. The raw water enters from the main, under about 20 lbs. per sq. in. pressure, at the pipe shown in the upper right hand of the cut. Thence, it passes through a balanced float valve to the sedimentation tank, being at the same time treated with the sulphate of alumina. After passing through this tank, it goes out, through the outlet box at the top, to the mechanical filtration tank and from there out to the storage tank, to be available for use. The top of the entrance tank is the same elevation as the top of the filter tank while all of the rest of the system is lower so that the plant works under a low head. In this tank there is also a float valve which controls the flow so as the filter does not overflow. In operation the whole system is automatic, supplying only as much water as needed, and the flow varies from practically nothing to the maximum of 115 gals. per min.

In Fig. 2 are shown the details of the sedimentation tank. It is built entirely of reinforced concrete. The water entering at the top through the small reinforced-concrete float or entrance tank is passed down under a baffle wall and along the whole length of the sendimentation tank, through an opening in the longitudinal dividing wall and thence along the other side and out through the small outlet chamber to the filter tank. Provision for cleaning the sedimentation tank is made by two 5-in. clean-out pipes on the bottom of the tank. During this cleaning, which is carried on during half holidays or Sundays, while the mill is shut down, no attempt is made to operate the filter as the water is so muddy that in its raw state it would soon clog the apparatus. After the water has drained out through the pipes a stream of water from a hose placed through the manholes completes the cleansing.

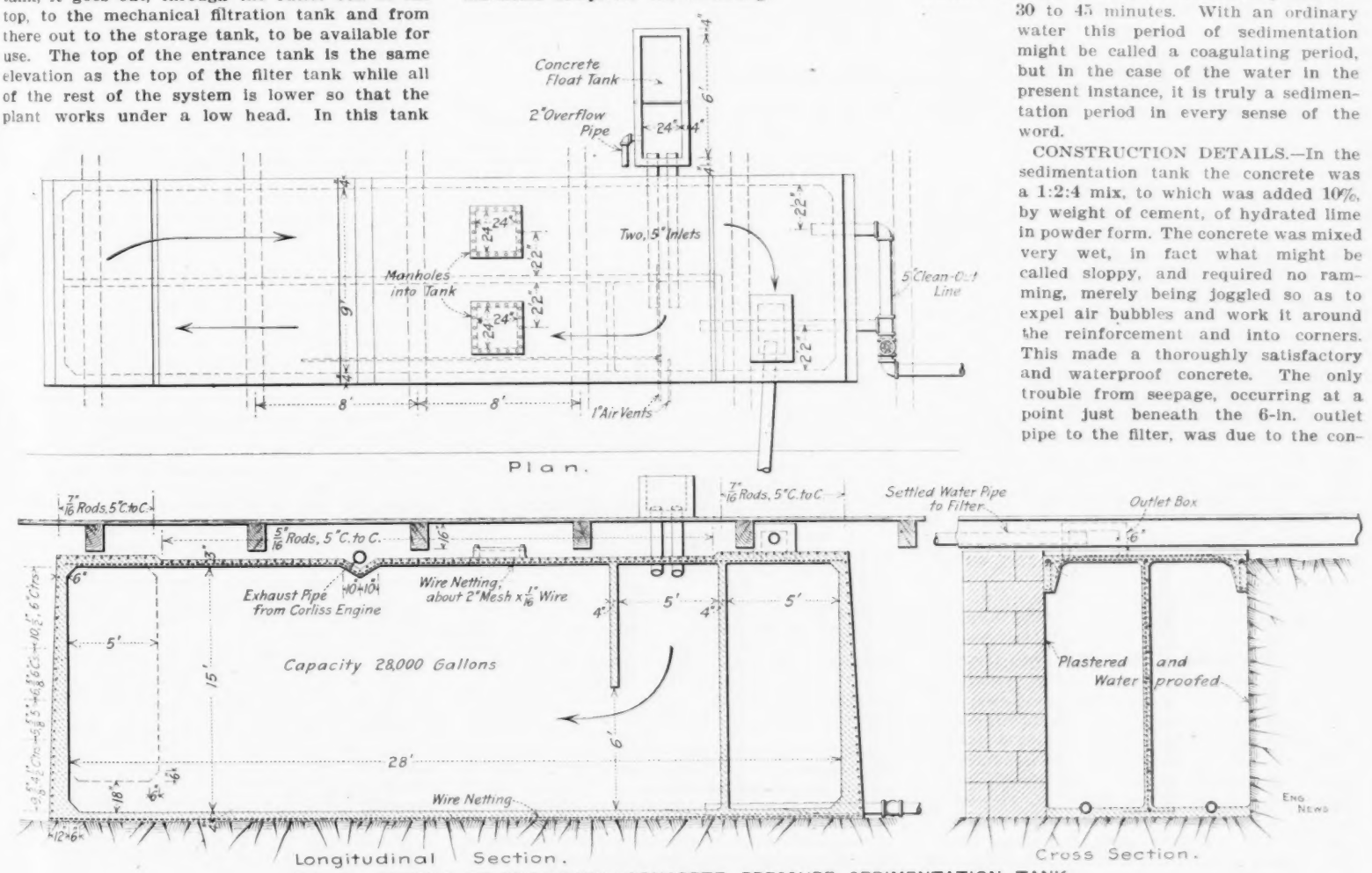


FIG. 2. DETAILS OF REINFORCED-CONCRETE PRESSURE SEDIMENTATION TANK.

It was originally intended to place a butterfly valve on the pipe at the inlet chamber, but it was found necessary, owing to the conditions under which this plant had to operate, to instal a balanced float valve that would close perfectly tight against a considerable pressure. One of the principal requirements for this plant and somewhat unusual for one of the gravity type, was that it should be almost automatic in its action, whether the mill was using 25 gals. of water per min. or 415 gals. of water per min., the guaranteed capacity of the plant. This, of course, prevented the use of a float and butterfly valve, which will not close tight against any considerable head, when operated by a float.

The water levels in the concrete float tank and in the filter are practically the same when only a small portion of the plant's capacity is in use and actually the same when no water is being used. When the plant is running at full capacity, however, the water level in the filter falls to just about 3 ins. above the top of the 6-in. inlet pipe from the sedimentation tank, although the water level in the float tank remains practically the same as before. The float tank as shown has a depth of only about 2 ft. and is placed as shown in order to provide the head necessary to operate the plant by gravity. The filter tank from top of the tank to the top of the strainer valves is about 8 ft. 9 ins., the thickness of the gravel bed is 1 ft. and that of the filter bed 3 ft. The head under which the tank operates depends entirely upon the amount of water being used, although if we leave out of consideration the outlet box, which may be merely likened to the enlarged end of the outlet pipe, 4 ft. 6 ins. is about the operating head, under which the water sediments.

The sedimentation period at full capacity (30,000 gals.) is approximately one hour, which is ample to remove about 75% of the suspended clay, providing the proper amount of coagulant is being fed. This sedimentation period may appear, at the first glance, to be possibly a little short, but the character of the water is such that it will, when treated with the requisite amount of coagulant settle satisfactory in from 30 to 45 minutes. With an ordinary water this period of sedimentation might be called a coagulating period, but in the case of the water in the present instance, it is truly a sedimentation period in every sense of the word.

CONSTRUCTION DETAILS.—In the sedimentation tank the concrete was a 1:2:4 mix, to which was added 10%, by weight of cement, of hydrated lime in powder form. The concrete was mixed very wet, in fact what might be called sloppy, and required no ramming, merely being joggled so as to expel air bubbles and work it around the reinforcement and into corners. This made a thoroughly satisfactory and waterproof concrete. The only trouble from seepage, occurring at a point just beneath the 6-in. outlet pipe to the filter, was due to the concrete not having been sufficiently joggled at this spot by the workmen; and to the fact that a great deal of difficulty was experienced in waterproofing a 4-ft. masonry wall and a rock face which formed the sides of the tank. This rock wall would have been concreted with the rest of the tank had it not been impossible to do so, on account of its irregular surface, varying in

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places some 2 ft. from the average plane of the rock. Having to waterproof the rock face anyway, it was therefore deemed unnecessary to concrete the masonry wall and it was waterproofed at the same time as the rock.

The reinforcing steel used was the ordinary commercial round bar and varied from ¼ to ⅞ in. in diameter, depending upon its location in the tank. All bending in the bars was done hot by a smith and helper in preference to cold bending. The forms were erected complete in one operation, including formwork for roof, and the whole tank then concreted in almost one continuous operation, working both a day and night gang. There were no joints in the work except between the roof and the walls, which joints were thoroughly washed and then given about 1 in. of 1:2 mortar before placing the concrete. The forms for the roof were also given ½-in. of 1:2 mortar before placing the concrete. All reinforcement was fastened in place as the building of the forms progressed so that when the form-work was completed all reinforcement was in place.

The two end walls were tied into place by ½-in. steel bars, one end of the bar being hooked around the horizontal reinforcement and the other being bent at right angles and driven into suitable holes drilled into the rock and masonry face, such portions of the bars as projected outside of the concrete being afterwards covered with mortar. A cross-sectional view of the roof is what might be termed a huge channel beam, the flanges of the channel being poured first, the hook bars "A" and the longitudinal bar "B" being first placed in position and the web corresponding to the roof slab poured after the flanges had set, with a mortar joint between. All of the transverse roof reinforcing bars were bent to the shape of an arc, the ends running underneath the longitudinal bar "B" so as to tie the web to the flanges, and the center of the bar being about 1 in. below the top of the roof slab as shown.

Except at the ends of the tank where the roof slab was tied down into the end walls the whole upward thrust of the roof, due to the head of water in the filter and float tank, was taken by the adherence of the "flanges" to the rough and uneven surface of the masonry and rock face side walls. One unusual feature of this tank was that the roof had to be reinforced against both the upward pressure, due to the head of water when the tank was full and to the downward pressure, due to the weight of the roof itself when the tank was empty.

Entrance to the tank is had by means of the two square manholes covered by square steel plates bolted down on round asbestos packing dipped in red lead.

The excavation for the tank was a very difficult matter, as it was in a place where the excavated material had to be shoveled into barrows, wheeled a short distance, dumped and passed through a hole about 12 × 12 in. square in the masonry wall; again shoveled into barrows and wheeled to dump. As about 30% of it was loose rock too large to go through the opening without sledging, it proved a very costly piece of excavating.

The entire plant was designed and built by the Engineering Department of the Philadelphia Water Purification Company, Inc., of Philadelphia, Pa., under the direction of the writer. The writer wishes to express his indebtedness for many valuable suggestions in the construction of the tank, to Mr. Clarence R. Neher, Engineer and Mr. William Buckles, Superintendent of the Atlantic, Gulf & Pacific Co., Whitehall, N. Y.

Handling Freight Traffic on Inclined Planes: The Ashley Planes (C. Ry. of N. J.) *

By C. H. STEIN.†

The Pennsylvania legislature on March 13, 1837, passed an act authorizing the Lehigh Coal & Navigation Co. to construct a railway to connect the North Branch division of the Pennsylvania Canal with the slackwater navigation of the Lehigh River. The object was to transport the coal from the Wyoming valley to the Atlantic seaboard.

Edwin A. Douglas, Chief Engineer, located the route from White Haven to Wilkes-Barre, and it was called the Lehigh & Susquehanna Ry. This involved what was then some marvelous engineering, including a tunnel nearly a third of a mile long, and a series of inclines upon which the cars laden with coal were lifted by mechanical means from the vicinity of Ashley to the summit of the mountain near Solomon's Gap, whence they were taken to White Haven by rail. There the coal was transferred to canal boats and passed on to the seaboard by way of the Lehigh Canal.

In June, 1862, floods caused the almost complete destruction of the upper division of the canal, and on March 4, 1863, the Pennsylvania legislature passed an act prohibiting its restoration. But in lieu thereof it granted a charter for the construction of a railway from White Haven to Mauch Chunk to connect with the line from White Haven to Wilkes-Barre, previously built. On March 16, 1864, a supplementary act was passed to extend the Lehigh & Susquehanna Ry. to Easton, Pa. This made a direct all rail route from Wilkes-Barre to New York harbor (by way of the Central Ry. of New Jersey).

Up to this period all freight and passenger traffic passed over the planes, but in 1866 and 1867 there was constructed what was known as the "back track" down the mountain side between Solomon's Gap and Ashley, over which all the passenger traffic and empty cars thereafter passed, and it is now known as part of the main line. For the handling of the heavy coal traffic, however, this would have involved a continuous climb from Ashley (170.27 miles from New York) to Solomon's Gap, a distance of 12.47 miles, and a total ascent of 1013.75 ft., composed of grades 95.61, 83 and 51.4 ft. per mile, respectively, and an average grade of 81.29 ft. per mile for the distance of 12.47 miles. The use of the planes was, therefore, continued for all eastbound coal tonnage. On April 1, 1871, the Lehigh & Susquehanna Ry. was leased to the Central Ry. of New Jersey, which has since operated it.

The inclines resemble one another, the only variation being the difference in the length and rate of grade. The steeper the grade the shorter is the plane. The total length of the planes from point of beginning where they leave the main line to Solomon's Gap, where they tap it again, is 13,020 ft., or 2.47 miles, as against 12.47 miles by the main line, or a decrease in distance of ten miles. The lengths and grades of the planes are as follows:

	Length.	Grade.	Rise.
3.....	5,000 ft.	5.7%	269 ft.
2.....	3,000 ft.	14.65%	422 ft.
1.....	3,700 ft.	9.28%	334 ft.

This makes a rise in the aggregate of 1,025.9 ft. The short, so-called level stretches of track between the planes descend to the extent of 5.4 and 6.75 ft., respectively, or a total of 12.15 ft., for the purpose of permitting cars when they reach the head of one plane to drift freely to the foot of the next one. This reduces the actual ascent by the three planes to 1,013.75 ft.

It must be kept in mind that the object of the planes is to overcome the small tonnage movement at low speed over heavy main line grades for a distance of more than 12 miles by a rapid movement of large tonnage over a short distance of only 2.47 miles over grades largely in excess of any upon which a locomotive could operate. This is accomplished by hoisting engines at the head of each plane, which, by means of large cables, haul the cars to the objective point.

The loaded cars are concentrated in the receiving yard close to the foot of the planes, where they are taken in drafts, six at a time, and placed over a truck pit (which will be described later) at the foot of plane No. 3. A man at this point, called a footman, by means of a bell signals to the engineman at the head of the plane that the cars are in position; he applies his power and a truck or "barney" which has been in the truck pit below is drawn up a set of inclined rails behind the cars. This barney is connected by a very heavy cable to the drum of the engine at the head of the plane. As soon as the engineman feels the barney go against the cars to be raised he speeds up his engine and the cars start their ascent of plane No. 3.

On each plane there are two parallel tracks, and at the foot of each one are two parallel truck pits. The cable from one truck or barney passes up the plane over sheaves about 22 ft. apart, then three times around the drums, 20 ft. in diameter, and out through the bottom of the power-house over a very large sheave, which returns the cable to a barney on the parallel track.

Thus, when one barney ascends, pushing up the cars, the barney which has been at the head of the plane descends, drops down by inclined rails into the truck pit, passes under six more loaded cars which have in the meantime been placed by the drill engine, and is now ready for its ascent. Simultaneously the first barney has reached the head of the plane with its cars; a brakeman takes charge of them, the engineman reverses his engine, the first barney starts on its descent, and the second one rises up by inclined rails out of the pit and goes behind the cars standing to receive it.

Attached to the rear of each barney is a lighter cable, passing back to a high gallows frame from which are suspended very heavy counterbalance weights, then around a large bull wheel, returning to the other barney. The purpose of this is to equalize any slackness in the main cables of either barney.

The process is now repeated, six cars moving alternately on one track on plane No. 3, then on the other one, with but slight interruption. The cars are delivered at the foot as fast as they can be drawn up the planes, or approximately so.

When the six cars have reached the top of plane No. 3 and are taken charge of by the brakeman they are cut in two parts and only three cars are handled at a time up plane No. 2. This is accounted for by the fact that plane No. 2 has more than twice the grade of plane No. 3. It is, however, only a little more than half as long. The operation, therefore, is so ingeniously carried

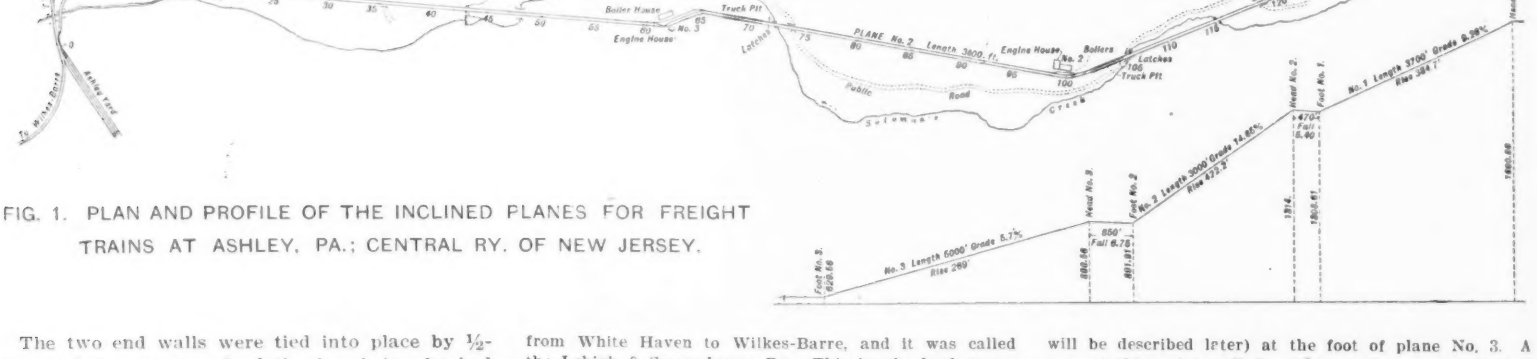


FIG. 1. PLAN AND PROFILE OF THE INCLINED PLANES FOR FREIGHT TRAINS AT ASHLEY, PA.; CENTRAL RY. OF NEW JERSEY.

*From an appendix to the report of the Committee on Yards and Terminals, presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association, at Chicago, March 16 to 18, 1909.

†Engineer of Maintenance of Way, Central Ry. of New Jersey, Jersey City, N. J.

out that the six cars in two drafts over plane No. 2 are handled in the same time as the six cars in one draft over plane No. 3.

Plane No. 1 is operated similarly to No. 2, at the head of which is a 200-ton track scale, 117 ft. long, over which all the cars pass at a speed of about two miles per hour and are weighed coupled together after they

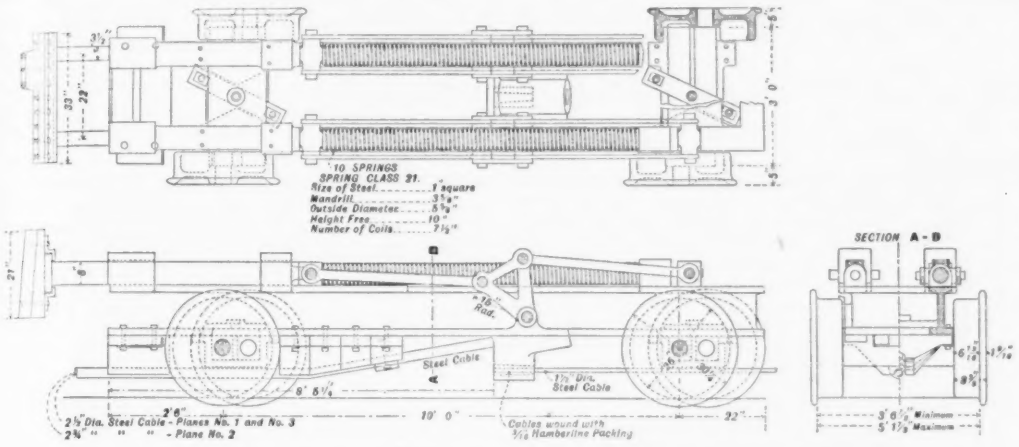


FIG. 2. CABLE PUSHER CAR OR "BARNEY" FOR THE ASHLEY PLANES.

have made the complete ascent of the planes. By experiment it has been demonstrated that the weights taken in this manner are practically without error. The cars may be drawn up the planes at speeds of from 12 to 30 miles per hour. The plan and profiles of the planes are shown in Fig. 1. The information is given in the accompanying table:

FREIGHT INCLINES AT ASHLEY, PA.: C. RY. OF N. J.

	Upper or No. 1.	Middle or No. 2.	Lower or No. 3.
Length of plane	3,700 ft.	3,000 ft.	5,000 ft.
Length of truck pits	391 ft.	397 ft.	428 ft.
Rise per 100 ft.	9.28 ft.	14.65 ft.	5.7 ft.
Total rise of each plane	334.7 ft.	422.2 ft.	269 ft.
Fall between planes	5.40 ft.	6.75 ft.	.....
Distance bet. planes	470 ft.	850 ft.	.....
Total rise, Ashley to Solomon's Gap	.....	.....	1,013.75 ft.
Total distance, Ashley to Solomon's Gap	On slope	.....	13,020 ft.
Slope angles	5° 18′	8° 20′	3° 15′
Length of main cable	4,640 ft.	3,670 ft.	5,780 ft.
Diameter of main cable	2½ ins.	2¾ ins.	2½ ins.
Weight per foot	10½ lbs.	11¾ lbs.	10½ lbs.
Length of tail rope	4,023 ft.	3,320 ft.	5,520 ft.
Diameter of tail rope	1½ ins.	1½ ins.	1½ ins.
Weight per foot	3¾ lbs.	3¾ lbs.	3¾ lbs.

The chief and interesting feature of this plant is the manner in which the barney can pass down into the truck pit underneath the cars and then out of it again and up behind them. It is accomplished by the ingeniousness of the track devices, and by the fact that the wheels of the barney can adjust themselves to any gage. For the latter purpose the axles of each wheel are independent of each other, sliding in sleeves, the one set just forward of the other, and held in place by an equalizing or lazy crank, which adjusts itself to the gage of the wheels.

The construction of the barney is shown in Fig. 2. It weighs 7 tons. It will be observed that the axle of one wheel passes just to the side of the axle of its mate. Another peculiarity made necessary by the operation is that the flanges of the wheels run on the outside of the rail. The flanges of the wheels are 2⅛ ins deep and the treads $6^{13}/_{16}$ ins. wide.

The track arrangement is shown in Fig. 3. The descending barney descends along the running rail A, which is also the rail on which the traffic cars run. As it reaches the wing B the flanges spring it out, and the treads of the wheels ride on the rail C, changing their position from the track rail A, which lies on the top of the side wall of the pit to the pit rail C. At the point D there is a deflector which guides the flanges of the wheels away from the switch point, so that they might continue uninterruptedly into the pit on the rail C. (This deflector is simply a boss on a filler block which diverts the flanges of the wheels from the switch point.)

The barney has now reached the interior of the pit. It passes on down to the end (with the wheel flanges on the outside of the pit rail), springs the switch point E out, and passes through. It has now reached the point where it is ready to make the ascent. The pit is about 5 ft. deep. The rail F ascends this 5 ft. to the top of the pit wall in about 30 ft., where it parallels the main running rail A, on which the cars stand ready to be raised.

The footman signals the engineman at the top of the plane; he starts the engine, and the barney starts up the 30 ft. of inclined rail F, and goes against the cars. The engine is then gradually speeded up and the cars start up, the car wheels traveling on rail A, the barney wheels on rail F. They spring open the switch at D, the car wheels continuing on rail A, but the barney wheels being transferred to rail C, after passing point D, the car wheels are not further interrupted.

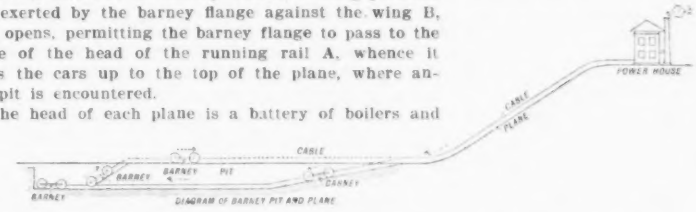
But when the barney wheels reach point G they come in contact with the guard rail there, which is 3⅛ ins. higher than any of the running rails. This pushes against the inside of the barney wheels, causing pressure to be exerted by the barney flange against the wing B, which opens, permitting the barney flange to pass to the outside of the head of the running rail A, whence it follows the cars up to the top of the plane, where another pit is encountered.

At the head of each plane is a battery of boilers and a vertical engine which furnishes the power independently for each plane. Their rating is as follows:

	Plane No. 1.	Plane No. 2.	Plane No. 3.
HP. of boilers	1,500	2,000	1,500
HP. of engines	1,200	1,200	1,200

The number of cars that can be conveniently handled over the three planes per hour averages 45; 60 cars may be handled with a little additional effort. The average tonnage for 24 hours has been 32,424 tons by actual demonstration. The economy of the boiler plant has been very largely increased during the past several years by the installation of a patent blower system, which resulted in a decreased cost of fuel. The planes are not constantly in operation during the entire year, nor during the entire 24 hours of a day, but to furnish some idea of the efficiency of the plant the following figures will be of some interest:

Number of days worked	305
Coal tonnage hauled	4,827,104 tons
Coal tonnage and weight of car	6,832,935 tons
Merchandise tonnage hauled	974,800 tons
Coal and merchandise tonnage hauled in one year	7,807,735 tons



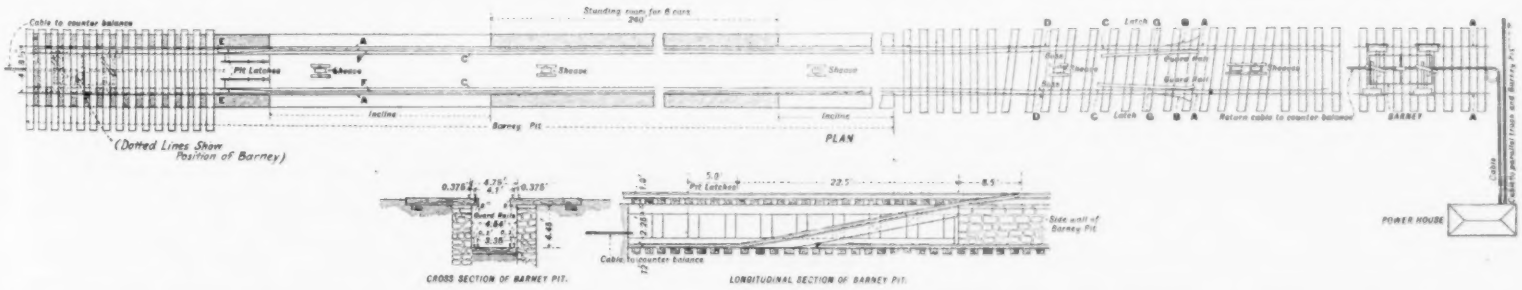


FIG. 3. TRACK ARRANGEMENT FOR AUTOMATICALLY SWITCHING THE "BARNEY" CAR FROM THE DESCENDING TO THE ASCENDING TRACK IN THE PIT UNDER THE FREIGHT CARS.

A haul of ten miles is saved by this plane. As the tonnage is practically all anthracite coal that is mined within 20 miles of the plane, and as the location of the plane is central both for assembling the loaded cars and distributing the empty cars, the advantage of gain in time by this route and method of handling must receive consideration, as well as the saving in cost of handling. On the longer locomotive route there is a single-track tunnel, about 4,000 ft. in length, operated on the train-staff system.

The summit on that route is only 120 ft. lower than the summit at the head of the plane. Therefore, the conditions involve ten miles excess distance to save a lift of 120 ft. When half of this excess distance has been traveled, the advantage has been absorbed, and there are still five miles to be run with no compensation. This feature, however, has little bearing in the case of yards and terminals, where the argument as to the economy of the short and steep plane as against the longer haul on a line operated by locomotives is not applicable.

When it is considered that one of the grades over which the cars have to be raised is 14.65% for a distance of 3,000 ft. the suggestion forces itself upon us that the application of this principle to the operation of hump freight yards has much promise in it. As many cars could be handled over the hump as could be delivered by an engine from the receiving yard. The attractive feature would be that the operations on the hump would be conducted from a point where the movement of the train would be absolutely under the control of one who had clear observation of all that was going on. It would not be necessary to pass signals to the rear end of the train, with the consequent delays and troubles.

The expense of operation would not be so great as in the case of a plane, on account of the speed being so much lower. There would not be the same wear and tear on machinery. The feeder engine bringing cars from the yard would have ample time to keep the truck pit supplied, hence there would be almost a continuous movement over the hump. The indications are that cars could be classified successfully by this method, and with greater economy in cost than by any method in vogue up to this time.

The Mahanoy Plane (Philadelphia & Reading Railway).*

A profile of this plane is shown in Fig. 4. The cars to be lowered are dropped against the barney standing at the top of the plane. At the same time the other barney is in the pit at the foot of the plane and the cars to be hoisted are pushed over it by a poling engine.

The winding engine at the top of the plane is then started very slowly until the barney at the foot has risen out of the pit and has come in contact with the cars in front of it. In the meantime the cars to be lowered are over the knuckle at the top and are ready to be handled at full speed. The engines are then given speed and the cars are moved up and down at a speed about 2,500 ft. per minute until near the end of the movement, when the speed is reduced to about 1,000 ft. per minute and the barney runs into its pit at the bottom of the plane and the cars that were lowered pass over it and are caught by car riders and stopped on the tracks provided to receive them. The cars hoisted are also caught by car riders and made up into trains for further movement.

A trip on the plane consumes 2½ to 3 minutes, or the plane handles 20 to 25 trips per hour. The load is 125 to 130 tons per trip hoisted and lowered 351 ft. If the winding engines are run with cars on one side only the load is 100 to 105 tons handled in the same time.

*By F. [illegible] Stevens, Superintendent, Philadelphia & Reading Ry., Reading, Pa.

Track Elevation Work on the Chicago, Burlington & Quincy Ry.*

By F. L. STONE.†

The plans, estimates and execution of the work are under the direct charge of the engineer of track elevation, except that in matters directly affecting the operation of the road the division superintendent is consulted. This arrangement has been followed for the last two years and proved fairly satisfactory, though a different superintendent served each year. Such an arrangement cannot be recommended for general use, for, to be successful, there must be harmony, and this is not always possible where authority is divided.

The detail of our organization is as follows: Engineer of track elevation, having general supervision of plans, estimates and execution of the work. To him report: (1) superintendent of construction, in direct charge of all work handled by company forces; (2) assistant engineer in charge of surveys, plans, estimates, lines and grades and drainage; (3) assistant engineer in charge of contract and subway work; (4) assistant engineer in charge of accounting; material clerk, in charge of stores and supplies; timekeeper.

The design of retaining walls and bridges is under the bridge engineer; he also furnishes inspectors, who report direct to that department. To the superintendent of construction report the following: (1) the general carpenter foreman, in charge of temporary bridges, forms and concrete; (2) the roadmaster, in charge of filling and all track forces; (3) the yardmaster, in charge of switching and work trains.

The engineer of track elevation directs all plans and estimates, arrangements with other roads and industries, outlines to law department matters to be adjusted with the city, approves all orders for materials and all bills of expense, directs general procedure of work as to methods and amount of force, whether by company forces or by contract. The superintendent of construction is in direct charge of the work which is performed by labor employed by the company. He reports to the engineer in all matters relating to the work, and takes instruction direct from the division superintendent as to operations which affect the handling of traffic.

As our operations have all been on our main line with heavy traffic, the train movements and signals have been handled by the regular operating force, the engineer of track elevation and division superintendent agreeing on the general procedure for doing the work. The superintendent of construction makes detail arrangements with the proper operating official for the daily work.

The Burlington company has been one of those which have made a practice of doing practically all of the work on its right-of-way with company forces. This, the writer believes, is economical, but could be made more so if the work were handled in the same manner as contractors handle it. Contractors have proved the rule that foreman and sub-foreman must be competent and fairly paid, and that the amount of work handled by each must not be greater than can be directly overseen, each man in charge being held accountable for the cost and quality of work.

If an organization should be developed to handle all excavation, carpenter, and concrete work on a basis as proved economical by contractors, the company would save several thousand dollars yearly. To accomplish this, the company must authorize the engineer to pay for work done and not a rate per man, which is the customary rule. The engineer, if competent to handle the work under one method, is competent to determine whether the cost of work will be increased or decreased by the use of a higher grade labor.

The writer is a firm believer in company work. There is no reason why forces employed by the company cannot do work as cheaply as anyone, providing the quantity of work to be done warrants the forming of an organization. Our cost results show favorably with contract prices. The main economy lies in the ability to shift the labor on account of unavoidable delays, so where a contractor might have a claim for extra compensation, the company would get full value on other work.

Our filling is loaded by steam shovel in side-door cars, hauled by work train, unloaded by Lidgerwood unloaders and spread by Jordan spreaders. The loading and work train were handled under the direction of the division superintendent at Aurora. The filling pit is located a few miles distant from the division headquarters, so that train crews are called two hours ahead of departure time.

Each night the superintendent of construction advised the superintendent's office by telephone as to operations at the pit, to ascertain the quality or kind of material and amount or number of trains and time they were to be dispatched. The regular schedule was three trains daily of 35 cars each; maximum number handled, 5 trains. The trains were run into a storage track convenient to the work and divided into two or three parts, for facility in unloading. Our experience indicates no economy in trying to take more cars at one time than can be handled easily by the switch engine on the rough construction tracks and approach grades.

The unloading track, or construction track, as it was called, was built with 75-lb. rails and oak ties, and was kept thrown close to the edge of the fill by jacks. In throwing the track the side nearest the edge of the bank was kept from 4 to 6 ins. high. The work train would compact the fill until this side was from 4 to 6 ins. low, when the operation would be repeated. The spreader cut was so adjusted that one or two cuts could be unloaded before spreading.

Under operating conditions imposed this year, we found 4,000 cu. yds. to be the economical average for one plow and spreader. By having a sufficient number of cars in service so that material is always on hand, the economical average might be increased to 5,000 or 6,000 cu. yds. This would require additional storage room, more switching, and a larger area of construction space.

Our company has always insisted in both doing the work and handling all business in same territory. The writer is not in sympathy with this policy, as the strenuous life is too long continued. Some companies turn over as large an area as possible to construction and then rush the filling as fast as possible, thus giving the area back to the operating department, and leaving a full season to devote to concrete, bridges and subway work.

Our material consisted of glacial drift, covered with from 12 to 24 ins. of loamy soil. The drift varied in size from fine sand to medium gravel. We selected the cars containing good gravel for ballast and used this on top, so that no special ballast was required. After being compacted by the work train, but little work was required to keep the new tracks in good surface.

Temporary bridges were used at intersecting streets and were built continuous across the right-of-way, so that tracks might be thrown on the bridges at the same time as on the embankment. We used double caps to save labor in keeping the bridge decks to surface. This feature reduced the maintenance to less than half. In crossing the P., C., C. & St. L. Ry., C., T., T. Ry. and C. J. Ry. (in all eight tracks), we placed the permanent bridges, consisting of two through-girder spans in place on steel columns, making the approaches by trestle.

*From the report of the Committee on Roadway, presented at the annual meeting of the American Railway Engineering & Maintenance of Way Association; held at Chicago, March 16 to 18, 1909.

†Engineer of Track Elevation, C., B. & Q. Ry., Chicago.

THE FREIGHT-CAR SITUATION IS STATIONARY at about 300,000 cars idle, according to the American Railway Association's report for March 3. In the preceding two weeks, the box-car surplus decreased by 14,700 (to 83,779), while the coal and gondola cars increased by the same amount (to 149,986). Slight changes in the surplus of flat cars and other kinds changed the total from 301,441 on Feb. 17 to 299,925 on March 11.

A Novel Arrangement for a Rolling-Lift Bascule Bridge in Burma.

A bascule bridge of the Scherzer rolling-lift type has been built in Burma, which has an unusually wide channel opening. It has also a novel arrangement of the anchorage for the leaves of the draw (when closed), and of the track girders which carry the rolling heels of the draw span (when open). In most bridges of this type the track girders form short independent spans, having both ends supported by piers. In this case, however, the river is subjected to heavy floods in the rainy season, and as obstructions tend to cause severe scouring of the river bed it was desirable to have as few piers as possible. The girders therefore are framed between the floor beams of the end panels of the approach span, thus eliminating two piers. The general arrangement is shown in Fig. 1. Fig. 2 shows the completed draw in the open position, with its overhead anchor girders.

When the bridge is closed, the tail of each lift of the draw is some distance back from the pier, and the uplift has to be transmitted from this point to the anchorage in the pier. For this purpose, heavy posts (A C, Fig. 1) are built at the first panel point of the approach span, extending above its top chord, and carrying between them (at A) a transverse "bumping girder." When the draw is closed, the top of the rolling heel of each truss takes a bearing on the bottom of this girder, from which the stresses are transmitted through the truss members of the fixed span to the anchorage. The posts and bumping girders are clearly seen in Fig. 2.

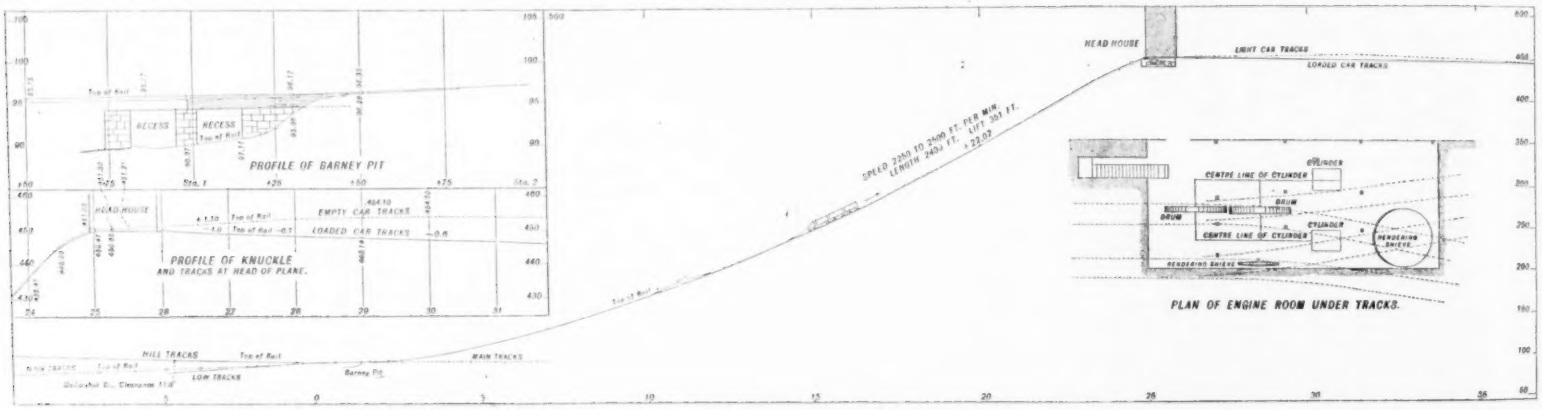


FIG. 4. PROFILE OF THE MAHANOY INCLINED PLANE; PHILADELPHIA & READING RY.

This bridge crosses the Ngawun River, and carries the extension of the Burma Railways Co. from Henzada to Kyangin. The railway is of meter gage. There is a considerable navigation by river steamers and the government authorities required a clear channel of 200 ft. It was originally intended to have a fixed bridge with a headway of 40 ft., but this would have involved long approach grades. It was therefore decided to reduce the grades and approaches and to provide a draw span for the channel opening. This span is a double-leaf through truss structure 220 ft. long c. to c. of bearings. It is flanked at one end by two fixed through-truss spans of 160 ft., and at the other end by three similar spans. These are of the type shown in Fig. 1, but the high posts (A C) and their top chord connections are used, of course, only on the spans adjacent to the bascule span.

As native labor is cheap and plentiful the bridge is operated by hand. The gearing is driven by winches mounted on platforms outside of the approach spans, and transmits the power to pinions gearing with the two operating struts of each leaf. These struts are horizontal, in line with and directly above the top chords of the fixed span. With the fast speed gear and white labor, the bridge can be operated in about three minutes, but with native labor the operation will take a longer time. The weight of each leaf is 171 tons, and the load upon each channel pier is about as follows: rolling load, 171 tons; dead load of approach span, 40 tons; live load, 146 tons; impact, 7 tons; total, 434 tons.

The substructure consists of brick piers on

cessons sunk by means of wells, in accordance with general practice in India. The fixed spans were erected on falsework composed of frame bents resting on piles, each span having four towers of two bents each. The leaves of the bascule span were erected in the open position by means of a sliding derrick which was raised on the leaf as each panel was completed. The bridge was designed to meet the requirements of the specifications of the Public Works Department of the government of India. The substructure was completed and erection of the superstructure commenced in the spring of 1908, and the bridge was opened for traffic in December.

The work was under the supervision of Rendel & Robertson, Consulting Engineers, of London. The bascule span and the two flanking spans were designed by the Scherzer Rolling-Lift Bridge Co., of Chicago, and Mr. James I. Vincent was the company's resident engineer. The superstructure was built by Spencer & Co., of Melksham, England, and was erected at their works before being shipped. The substructure was designed by the railway company's engineers, and was built under the direction of Mr. G. Mills, Chief Engineer of Construction. The construction of the superstructure was under the direction of Mr. J. A. Despeisis, Superintendent of Ways and Works.

A ROAD PATROL SYSTEM is to be established by the newly created State Highway Commission of New York, according to press reports. It is said that the system will be similar to the one in use in Massachusetts, and that under it there will be 180 men, each provided with a horse and cart and having responsible charge of the maintenance of 10 miles of road.

A STATE SCHOOL OF SANITARY SCIENCE AND Public Health at Cornell University is proposed by a bill introduced in the New York Legislature. Provision is made for both instruction and research work, the latter to include "experiments on the disposal of sewage and of trades wastes, particularly when required by the State Commissioner of Health." Attention would be given to "the tabulation and interpretation of vital statistics, particularly those of municipalities." Provision is also made for cooperation "with boards of education in giving instruction to teachers and pupils in the secondary schools, in matters pertaining to school hygiene."

Tests on the Bonding of New Concrete to Old.*

By E. P. GOODRICH,† M. Am. Soc. C. E.

The writer's experiments were arranged with the following objects in view:

(*a*) Measurement of actual tensile strength with five methods of bonding, applied to two varieties of surfaces, and after two different time intervals;

(*b*) Determination of the qualitative effect of exaggerated temperature changes on samples representing cement floor or sidewalk finish, placed after a relatively long lapse of time, with the help of acid treatment, as compared with simultaneous placing of the bottom and top layers;

(*c*) Determination of the advisability of depositing concrete for a deep beam in separate layers with intervening time intervals;

(*d*) Determination of the best point at which to splice concrete floor members between successive days' work;

(*e*) Value of acid treatment in ordinary floor and walk work.

The tension tests were made on standard cement briquettes. Only 1:2 (by weight) Portland cement mortar was tested.

All specimens were cured in air only, to be more nearly analogous to practical working conditions. Splices were made after intervals of 24 hrs. and of 7 days. All specimens were broken at the end of 30 days. For the sake of comparison, unspliced specimens were molded and broken after the same period. One series of briquettes was made and broken after 24 hours. The half briquettes thus obtained were utilized in one series of experiments, half of them being spliced after a lapse of 24 hours and the other half after 7 days. It was considered that this series would represent conditions when the surface of old work was entirely broken away and all loose material removed just before the new material was deposited. Another series of briquettes was molded with a thin strip inserted at the smallest section. When

*Portion of Paper presented to the American Society of Civil Engineers, March 3, 1909. Published in the Proceedings of the Society, January, 1909, p. 15.

†Consulting Engineer, 1170 Broadway, New York City.

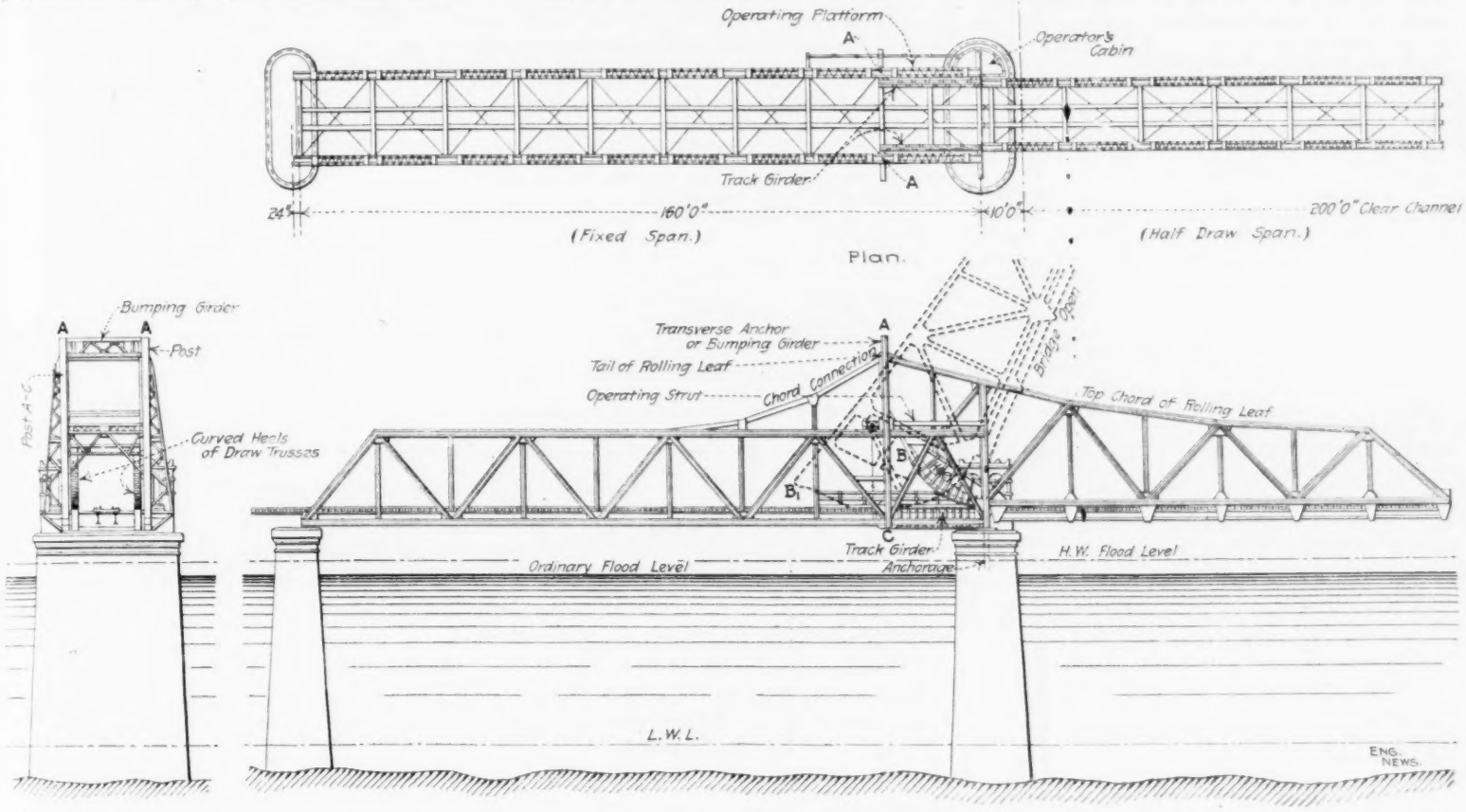


FIG. 1. PLAN AND ELEVATION OF HALF SPAN OF ROLLING-LIFT BASCULE BRIDGE HAVING ITS TRACK GIRDERS CARRIED BY THE APPROACH SPAN; BRIDGE OVER THE NGAWUN RIVER, BURMA RAILWAYS CO.

(Scherzer Rolling-Lift Bridge Co., Chicago, Designers of Superstructure.)

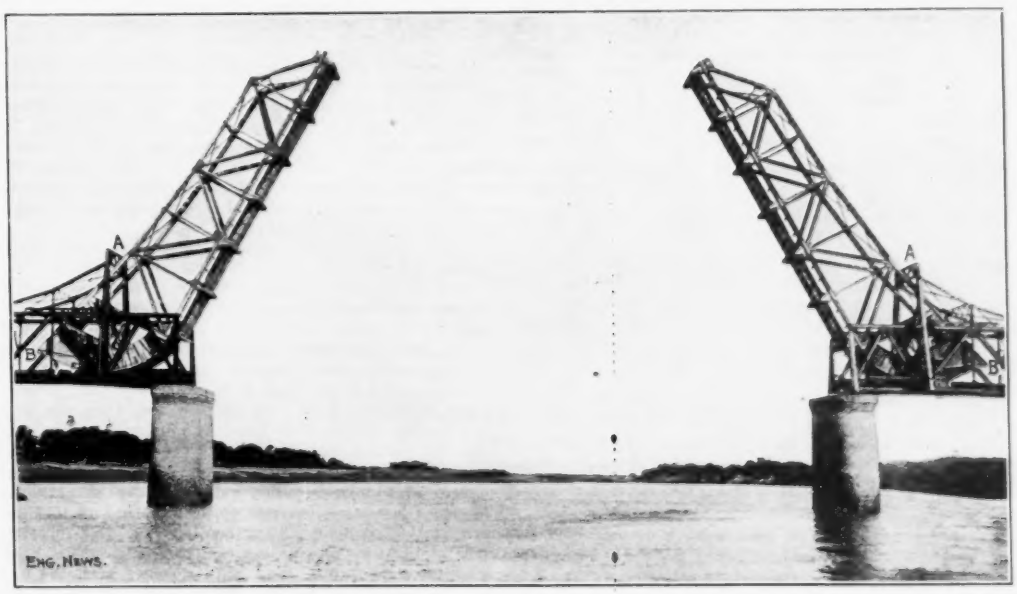


FIG. 2. ROLLING-LIFT BASCULE BRIDGE WITH 200-FT. CLEAR CHANNEL OPENING; BURMA RAILWAYS CO.

At (A) are the transverse girders which take the uplift of the tails (B) of the rolling leaves, when the bridge is closed.

removed from the molds, of course, these briquettes fell apart into two pieces, the surface next the partition having the exact appearance of having been molded against a common wooden form. After 24 hours, and 7 days, these half briquettes were spliced, the surfaces to be bonded first being indented with a sharp steel tool in just such a form as would be given with a pickaxe or blunt chisel, according to the usual methods of roughening surfaces to be joined. Five methods were used in making bonds, or rather in connection with the making of the bond:

(*a*) The soft mortar was molded against the half briquette with only as much manipulation as is usual in depositing concrete work. The old half was used dry in its natural state.

(*b*) The old half briquettes were first soaked in water for about 10 min. and then the new end was molded as in (*a*).

(*c*) A creamy mixture of neat cement was prepared, and the ends of the half briquettes were dipped in it. This formed a coating similar to that most often specified and used. The new ends were then molded in the usual way, before the grout had set to any great extent.

(*d*) The ends of the old briquettes were liberally washed with a 1:10 solution of commercial hydrochloric acid. They were then washed in clear water to remove all unspent acid, and the new ends were molded as usual.

(*e*) A solution of "Bonsit" (a patented powder) was prepared in accordance with the directions sent with the can, or at the rate of 5 lbs. of the powder to 10 gals. of water. This solution was then used in the same manner as in (*d*).

Three specimens representing age, type of surface, and method of bonding were prepared.

Mortar specimens were decided upon, because it was believed that it is the mortar which has been flushed to the surface and against the forms on each side of the joint, which is the real bonding medium.

Briquettes were used for several reasons:

(*a*) Measurements of the true tensile strength of the bond could be most easily obtained.

(*b*) With the small size of the specimen it was thought that one would be more likely to obtain more uniform results than with specimens of larger size.

(*c*) If good results could be obtained with small specimens, a standard would be provided to be applied over larger areas.

There may be some question as to the truth of assumption (*b*), because, over larger areas, local deficiencies would be merged with strong sections, so that a somewhat smaller variation would probably be obtained. The actual wide variation, in some cases, is instructive as to the probable conditions at different points in any joint. The narrower range found with some methods of bonding demonstrates, if anything at all, that it is possible with them to gain a better distribution of stress over larger areas than with the other methods.

The powder when put into solution gave a white precipitate when tested with barium chloride, showing that the acid in this case is sulphuric.

The results obtained from the tension bonding tests are contained in the accompanying table.

While the results in the table are not as concordant as might be wished, still certain deductions may safely be made:

(*a*) The best results were obtained with surfaces having the roughness produced by the natural fracture. This points toward a purely mechanical bond, or one with little cementitious action.

TABLE SHOWING BONDING TESTS.

	Rough Surface. 24 Hours. Each.	Aver-age.	7 Days. Each.	Aver-age.	Smooth Surface 24 Hours. Each.	Aver-age.	7 Days. Each.	Aver-age.
Plain.....	161, *C*, 92	126	285, 313, 343	314	162, 205, 80	149	*C*, *H*, 15	15
Soaked.....	*H*, *H*, 60	60	138, 218, 212	189	165, 90, 208	154	*H*, *C*, 44	44
Grouted....	380, 315, *C*	347	347, 280, 200	276	98, 43, 160	100	*H*, *H*, *H*	...
HCl.....	68, *C*, 155	112	126, 175, 221	174	87, 232, 105	141	83, 51, 44	53
"Bonsit"...	30, 60, *H*	45	152, 105, 95	117	79, 54, 68	67	172, 26, 114	104
Average....	147	...	207	...	122	...	69	...

Whole Briquettes.
363
384
309
438
415
304
427
Av. 377

H = Broken while handling before expiration of 30 days.
C = Broke in testing machine while adjusting clips.

(*b*) Practically no bond was obtained on surfaces which were molded against forms and had dried for 7 days. This is shown by the large percentage prematurely broken, even with careful handling, and the relatively low results obtained at best. Thorough soaking of the old work is essential.

(*c*) It was noted with regard to the 7-day, smooth surface, grouted bond, that the water was absorbed so rapidly from the grout as to render it an actual detriment. However, the results obtained with regard to the 24-hour and 7-day, rough surface, soaked, specimens might lead one to infer that there is a possibility of using too much water. This latter may be the case in laboratory work, but, in the writer's building experience, few laborers have ever been met who were prone to use water to what seemed an excess. In applying stucco work, or lining reservoirs, however, an expert workman knows that there is a real possibility of too completely saturating the old work, and it requires long experience and great care to obtain exactly the proper humidity.

The use of dry cement sprinkled over old concrete surfaces which have first been dampened is of questionable value, in view of the writer's experience.

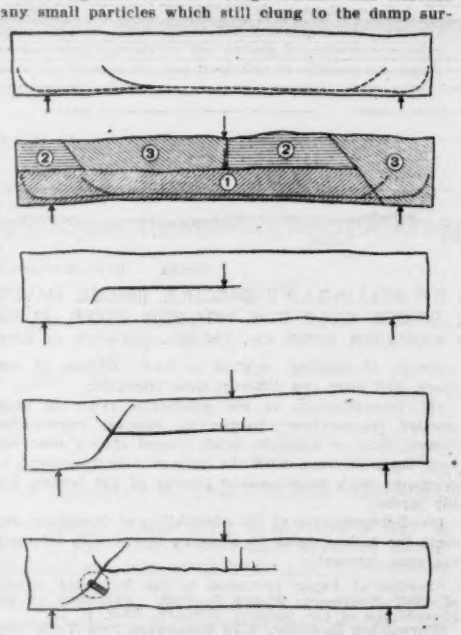
(*d*) A coating of grout is advantageous, first having soaked the old concrete thoroughly to prevent the water in the grout from being absorbed too rapidly.

(*e*) Acid treatment at an age of 24 hours is not of appreciable value.

(*f*) On surfaces originally molded against forms, after having dried for 7 days, acid is advantageous.

(*g*) Results with the use of acid were more consistent among themselves than with any other method.

(*h*) Why the splices made after the 7-day interval are so much better than those made after 24 hours on the rough surfaces, is difficult to explain, unless it be that the breaking to obtain this rough surface had loosened many small particles which still clung to the damp surface while only 24 hours old, but which were naturally removed during the handling incident to the 7-day tests.



Successive Steps in Construction and Test of Reinforced-Concrete Beam.

(*i*) The bonds secured on rough and smooth surfaces after 24-hour intervals are not materially different.

While the acid treatment does not give a bond as strong as when the old surface is rough-pointed, still its cost is much less, and where an absolutely monolithic condition is not essential, but where fairly good bond is required, the use of acid is of value.

Again, where proper reinforcement is provided across joints, the use of acid is advisable and sufficient.

The powdered material is much more convenient to handle than the commercial acids shipped in glass carboys.

The final experiment consisted in the fabrication of a reinforced-concrete beam, doing the concreting in sections, each succeeding part being deposited after a lapse of about a week from the last one, while the beam was tested after a final lapse of only two weeks after the last section was concreted. The several parts and the order of deposit were as shown in the accompanying figure. The mixture used was 1:2:4 (by weight), the broken stone being the run of the crusher, up to ¾-in. One of the patented bonding powders was used to better the connection between successive parts. The beam was tested, on a 6-ft. span, with a center load, the first application, up to 2,500 lbs., being applied at the neutral axis on two projecting rods which were cast in the beam for the purpose. The concrete section [illegible] 8 × 4 ins. over all, reinforced with two ½-in. sm[illegible] round rods placed ½-in. above the bottom of the [illegible], each one extending from one end to a point abou[illegible] ft. from the other point of support. Each end was [illegible] upward in a comparatively large-radius turn, the o[illegible] at the end through an angle of 90° and the other one [illegible] rough about 45°, so as to serve to some extent in re[illegible]ng diagonal tensile stresses. The reinforcement aggr[illegible]ed 1.34% of the effective beam area. The beam [illegible]shed about 180 lbs. The load was applied in increm[illegible] of 500 lbs. each, the effect of each being carefully [illegible]d.

The shapes of the sections were determ[illegible]d with the following objects in view:

(*a*) To determine the effect of a horiz[illegible]al joint in a beam, even when bonded as well as p[illegible]ible, where no steel is used for the purpose, when the load is applied at the level of the joint. This is the condition which exists in beams which are designed to be as deep as the distance between vertically adjacent window heads and sills in a concrete building, and where the concrete is almost invariably deposited in two seperate operations, with the joint between them occurring at the level of the concrete floor.

(*b*) To ascertain whether it were possible to secure, along surfaces theoretically close to those on which maximum diagonal tensile stresses are developed, a bond of sufficient strength to make it unobjectionable to stop work along such a surface.

(*c*) To ascertain whether there is any virtue in leaving a joint only along a surface theoretically close to those on which maximum diagonal compressive stresses are developed.

The test results obtained were as follows:

(*a*) At 2,500 lbs., applied at the center, a horizontal crack appeared, extending from the load toward one end and turning sharply downward into the mass concrete close to the turned-up end of one rod.

(*b*) The load was then shifted to the top of the beam, whereupon the horizontal crack disappeared entirely and the diagonal one was barely visible.

(*c*) At 1,500 lbs. applied on the top, a condition almost identical with (*a*) had been reached.

(*d*) At 3,500 lbs., the diagonal crack had extended downward and was following along the reinforcing rod toward the end of the beam. Very small tension cracks had appeared in the upper part of the beam under the load, and a wedge-shaped piece was commencing to crack out at a point where the diagonal and horizontal cracks intersected, in the vicinity of, but not along, an artificial joint parallel with diagonal compression planes.

(*e*) The load gradually fell to about 3,000 lbs., as more strain was produced, and all these cracks became more prominent, until a sliver of concrete was forced off, revealing the end of one rod cutting directly across the main diagonal crack.

The rod had slipped in the concrete near the end of the beam, but adhered firmly to that on the other side of the crack.

It is to be noted that the artificial joint, where diagonal failure was expected to occur, was closer to one point of support than was the crack which actually occurred at the other end. Thus the diagonal stresses were larger on the artificial joint than they were where the mass concrete failed.

The results obtained in this particular beam may be summarized as follows:

(*a*) In a beam, a horizontal joint not reinforced with steel, even if carefully bonded with acid and grout, is such a cause of weakness that the beam should be designed of a height only up to the joint, whenever the load is applied at the level of this joint.

(*b*) In a beam, a joint can be made sloping in the direction of the cracks caused by diagonal tensile stresses, which will be as strong as mass work, if the joint is bonded in accordance with the specifications given above.

(*c*) In a beam, the concrete in the vicinity of a diagonal joint parallel with the lines of maximum diagonal compressive stresses will fail before a joint made oppositely does, if incipient failure has already occurred in the vicinity of what may be called the compression joint and has not done so near the tension joint.

As a general conclusion, it may then be stated, that if proper bonding methods are adopted, with acid and grout, work may be stopped along 45° planes at any point in a beam, at pleasure, between the ends and the third points. In view of one other test reported besides the writer's, such planes would better be diagonal compression planes. The writer prefers such joints to vertical ones at the centers of beams, where direct tensile and compressive stresses are larger. Further, it is to be remarked that nothing but ample reinforcement, consisting of stirrups or numerous diagonal rods, can compensate for the detrimental effect of a horizontal joint left along or near the central axis of a beam. The writer prefers numerous stirrups, well connected to the tension rods, and amply anchored in the top concrete.

[Somewhat similar tests to those noted above were reported in Engineering News, Aug. 13, 1908, p. 167, and Dec. 12, 1907, p. 646.—Ed. Eng. News.]

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Whenever a low-grade city bridge crosses over steam railway tracks, the problem of the protection of the under surface of the bridge floor against the deteriorating influence of locomotive gases is of considerable moment. Not only must the rusting of the steel beams, where present, be guarded against, but the offense of the gases and smoke to those crossing the bridge requires a solid floor. With the old style steel girder and timber floor both of these difficulties were present and though with the advance to the buckle-plate and solid floor the latter difficulty has been removed, the tendency to rust still has to be resisted by some non-corroding material, usually wood, interposed between the locomotive passage-ways and the floor. Lately, the well-known ability of concrete to resist decomposition from locomotive gases has been utilized by building, across railway tracks, bridges with steel girders, floor-beams and stringers all covered with from 2 to 5 ins. of concrete coating as a protection against corrosion and carrying a solid jack-arch concrete or a reinforced-concrete floor system.

Admirable as has been the service of this construction, its novelty, particularly in the encasing of the steel members with concrete, has usually increased its cost above the regular buckle-plate solid floor bridges protected by a hanging ceiling against the gases. However, the city of Philadelphia, which has a great many bridges crossing railway tracks, has built a considerable number of these concrete protected steel bridges, and it is the experience of the engineers there that this style can be built just as cheaply and often more cheaply than any other form of protected bridge.

There are several reasons for this. In the first place the inspectors and the workmen now have had experience enough in the work to reduce the cost of concrete placing to a minimum, and the form work is thoroughly standardized so as to be inexpensive. So much for the cost of erecting. In first cost it is found that a concrete jack-arch or slab can be built for less money than a buckle-plate floor of the same strength. The floor-beams and girders on the concrete floor bridge are smaller for the same load because additional stiffness of the concrete allows a wider distribution of the concentrated load for which the floor system is always designed. The main girders, on the other hand, have a heavier dead load to carry on account of the concrete floor and have to be designed larger, but this increased dead load will hardly be enough to affect the size of the abutments or the foundations.

We have, then, to balance against the saving on both the floor itself and its supporting girders, the extra cost of main girders and of concreting around them and around the floor girders, and in the greater number of cases the concrete-covered structure proves the more economical. In addition the maintenance of this form is practically nil, whereas the costs of renewal and of painting on the older forms adds considerably to their capitalized first cost.

As a substitute for this new style of construction, the masonry arch, either of stone or concrete, and the reinforced-concrete girder bridge may be suggested; but the requirements for clearance at the usual railway crossing limits the opportunity of the former and the excessive ratio of dead to live load will act against the economical use of the latter. The concrete-covered steel girder with concrete floor seems to offer superior qualifications for such service.

On what grounds, if any, would a city be warranted in constructing a plant to manufacture paving brick for its own use? The "News" of Detroit, Mich., speculates on whether there is sufficient warrant for such a step in a clause of the new State Constitution adopted in November, 1908, which authorizes any municipality to "establish and maintain * * * all works which involve the public health or safety." It asks whether good paving is not a matter of public health or safety, and if not inquires, "How can the city own an asphalt plant?"

It seems to be putting an undue strain on public health and safety to try to justify either a paving-brick or an asphalt plant on that ground. The case for a municipal asphalt plant, quite regardless of matters of health or safety, seems far different from and stronger than that for a plant for the manufacture of paving brick. For it is one thing for a city to construct its own pavements and quite another for it to go into the manufacture of the paving material itself.

The strongest argument put forward by the "News" for a brick-making plant to be owned by the city of Detroit is the alleged high trust-made prices for paving brick delivered in that city. The line of argument runs as follows:

> Two-thirds of the entire output of the vitrified paving brick of the country is made in the Hocking Valley, and in 1905 there were made and sold in Ohio alone 224,096,000 of these vitrified bricks. The average cost for the five years between 1901-5, as shown by figures taken from the U. S. Geological Survey, was between $5 and $5.50 per 1,000, and the average selling price at the place of manufacture $8.10 per 1,000. Freight to Detroit costs $1.35 a ton, equal to $6 per 1,000 brick. Thus the average price of paving brick delivered in Detroit should not be any more than $14 per 1,000. This is between $7 and $8 per 1,000 less than Detroit is now paying, and means a saving of close to $100,000 annually if Detroit should determine to make her own paving brick.

It would really be interesting to see what Detroit would make of such an experiment as is proposed. We think it questionable whether it could show as good results in brick-making as in constructing its own asphalt pavement. And in saying this, we do not mean to commit ourselves one way or the other as to how satisfactory the operation of the Detroit asphalt plant has been, since we have seen no recent figures on the subject. In general, the cost of running municipal plants of this sort leaves quite out of account a number of important items which could never be ignored by a private manufacturer without great probability of falling into bankruptcy. Interest is frequently omitted, and depreciation is but rarely included, to say nothing of charges for fire insurance, employer's liability, and service rendered by the other city departments. The time when such omissions will be tolerated, however, seems to be rapidly passing. On every hand there are evidences that if municipalities are to extend their functions—or, in fact, whether they extend them or not—they must adopt adequate methods of accounting. When such methods have been more generally adopted, new municipal ventures may be entered upon with far less danger than at present, since there will be proper means of determining beyond question the extent of their financial successes and failures alike.

If anything at all is well established regarding reinforced concrete it is that the reinforcing steel must be kept clean from anything that would tend to destroy that bond between steel and concrete which is the safety of the joint material. Especially is the coating of the reinforcing rods with paint against possible corrosion a deplorable practice. It is not only unnecessary as a protective measure but the substitution of two planes of poor bond, concrete to paint and paint to steel, for the one strong bond of concrete to steel is certainly weakening from a structural standpoint. It is, then, with considerable surprise that we read in the Proceedings of the Fifth Annual Convention of the Maintenance-of-Way Master Painters, an organization of railway men, that

> All engineers are of the same opinion, that if a suitable paint—one that will withstand the ravages of the alkali—can be had, the trouble of rusting and corroding of steel embedded in concrete will have ended, and there is no doubt as to this.

Our surprise is not so great though, when we read that the extract is from a paper by a representative of a paint firm, looking doubtless toward a big field of business in the coating of all reinforcement with paint. His remarks are discredited by the ignorance of reinforced concrete displayed in such statements as "Concrete will not adhere to iron" and "Steel embedded in the very best stone concrete has rusted and corroded badly and some was entirely destroyed."

For the benefit of those master painters solicitous of the safety of the reinforced-concrete structures of their railways, we can assure them that the remedy for corroded reinforcement is not in their hands but with the constructing engineer, who is supposed to see to it that concrete encasing iron or steel is solid and non-porous. With a stone concrete, well made and thoroughly compacted, all evidence at our command shows no danger of iron corrosion.

The pilot, known in the vernacular as the cow-catcher, which ornaments the front end of American road locomotives, has always been a subject for ridicule by foreign railway men. Perhaps it has been partially responsible for keeping alive the tradition that the United States is still a jungle filled with wild animals and Indians. That the pilot is a valuable safety attachment to a locomotive, even on the highest class American railways, where cows, pigs and other stray livestock are not permitted to promenade, will be agreed by all American railway officers.

In fact, from two recent news items in the German technical press, we judge that European builders of locomotives for export might copy American railway practice in the matter of pilots with advantage to their customers. The first of these items records two recent collisions of trains with "wild elephants" on the Siam railway, near Bangkok. In both cases, it seems, the elephants were killed, although one of the animals was "large" (size of the other not stated). But the "large" elephant was ponderous enough to derail the train (although it was double headed and had 27 cars), tipping over both locomotives and telescoping six cars. These locomotives, surely, ought to be protected by cowcatchers designed for an elephantine rolling load; as fences and cattleguards cannot keep elephants off the line. The other item is the news that some heavy locomotives which a German firm is building for the Damascus-Mecca railway are to be provided with cowcatchers; not large ones, it is true, but sufficient perhaps to butt a stubborn camel calf off the track. So it seems that in this case the wild-animal conditions have been duly taken care of. If Siam will now make the necessary addition to its engines, so that America, Siam and the Arabian desert will class together, we may regard the cowcatcher to be fairly standardized for all railways which traverse a "howling wilderness."

Cable Inclines for Freight Traffic.

The use of steep-grade inclines (or inclined planes as they are commonly called) for operating railway lines over mountain ridges was a feature of the earlier days of railways, but is generally regarded as entirely obsolete. It will perhaps surprise many of our readers to find that this system is still in use in this country, for the reason that in certain cases it has been found more efficient and economical to handle loaded freight cars in this way than to handle them on the longer low-grade lines which have in later years been built to avoid the inclines. The low-grade lines are used for passenger trains and trains of empty cars. Two of these inclined-plane installations are described in an article elsewhere in this issue. They were both built in the early days of railways, and have been improved (especially as to their machinery and equipment) to enable them to handle the vastly increased traffic of the present day. One of them is to be widened for two additional tracks, giving two independent inclines. In each case there is a single cable for the two tracks, the cable being wound around a driving drum at the head of the incline, and having at each end a pusher truck or "barney" which pushes a string of cars up the incline. By an ingenious arrangement of track appliances, the "barney" descends and passes under a cut of cars and then rises in the rear so as to engage with the rear end of the last car as the cable is wound in by the drum.

The possible applications of such a system are, of course, very limited as far as general traffic is concerned, but it is of interest to note that the Yards and Terminals Committee of the American Railway Engineering and Maintenance of Way Association has suggested it as a promising possibility for handling cars on the "hump" of classification yards operated on the gravity system. Under the "hump" system, a train is pushed slowly up an incline to a summit, beyond which the detached cars (or cuts of cars) descend on a sharp grade which gives sufficient momentum to carry them into their proper classification tracks. In many of these hump yards, the grade on the ascending side of the "hump" is made heavy in order to save length, while in some cases the introduction of gravity switching has been found impracticable owing to the lack of room for the hump approach grade. Where the grade is heavy, it means that a very large engine or two engines together must be used to handle a train; or else that a train brought into the yard by one engine must be cut into two or more sections to be pushed over the hump, involving additional movement and consequent delay. In any case, the operation of these steep grades by locomotives is liable to reach an excessive cost.

The committee suggests, therefore, that the cable incline system for hauling trains by stationary engines up a steep grade to the summit of the "hump" may be worth considering in cases where more than one engine is required or where there is not room for an approach of such grade as to be efficiently operated by locomotives. The committee refers to the fact that the cable inclines in Pennsylvania (operating traffic over short routes with steep grades instead of over longer routes with grades practicable for locomotives) are still in use, although the problem of devising cheaper and more satisfactory methods has received considerable study. With locomotive operation, the speed of the ascending train on the hump incline is very slow, but greater speed would be practicable with the cable system. In fact, the description of the planes given elsewhere mentions speeds of 12 to 30 miles an hour on the inclines.

In regard to the feasibility of the application of such a system for gravity or "hump" switching yards, it is of particular interest to note that some such plan as this was contemplated by the late Walter G. Berg (Chief Engineer of the Lehigh Valley Ry.), who, at the 1908 meeting of the above named association made some remarks bearing upon the matter. It is known that he had been giving considerable study to the subject, but unfortunately nothing relating to this was found among his papers. From the little that was known by his associates and from the fact that he had had long experience in railway work in the Pennsylvania coal region where both the existing cable inclines are in use, it appears highly probable that the adaptation of this system to the operation of hump yards was in his mind.

Charter Making and Mending in New York, Boston and Berkeley, Cal.

Among the many efforts made of late to effect much-needed improvements in the government of American cities, charter reforms have perhaps been the most prominent. This is in accord with the unbounded faith which Americans seem to have in the betterment of their cities through changes in the form of their Government.

One hundred years ago the American form of city government was very much like that which was then and still is prevalent in Great Britain. During the past century there has been very little change in the essential form of British city government, notwithstanding the enormous development in municipal activities abroad and the generally high character of British municipal administration. In the United States the same period of time has witnessed a succession of kaleidoscopic changes which has been all the more remarkable because each of our many states has supreme control over municipal affairs within its boundaries, and thus has been free to experiment as it would.

But notwithstanding the great number and variety of changes which have been made in the form of city government in the United States, they are all, broadly speaking, of two general kinds, each of which is in striking contrast to the spirit of municipal administration in Great Britain. The first of these changes has been to greatly increase the powers and responsibilities of the mayor, and the second, which is really to a large degree involved in the first, has been to decrease the powers and duties of the city council. But not only by increasing the authority of the mayor, has the American city council been dwarfed in its power and functions. Before the responsibilities of the mayor were increased to the extent that is now becoming so general throughout the United States, there had been taken away from the council a large measure of its powers and duties, through the creation of independent executive boards charged with those large public undertakings, such as water-supply, sewerage and park systems, that have been characteristic of American city development. This formation of boards of water-supply and of public works was due not only to an unwillingness to entrust the expenditure of large sums of money to such untrustworthy bodies as a large proportion of our city councils proved themselves to be, but it was also due to a recognition of the fact that the planning and execution of engineering works were not fit tasks for a heterogeneous assemblage of councilmen chosen primarily, as has been so generally the case in the United States, for political reasons. In place of a large body of men brought together by the chances of politics, it has seemed best to Americans to entrust the planning and execution of their public works to small and compact bodies of citizens chosen with some regard to their fitness for the specific task in hand.

In this creation of separate boards for the construction and oftentimes for the operation of public works, we see a recognition of what had come to be, toward the end of the 19th century, a very distinctive principle of American city government, namely, the separation of legislative and executive or administrative functions. This separation was still further emphasized by the increased powers and responsibilities put upon the mayor. Experience showed that if the council itself selected or had the power of approval or disapproval of the members of these various executive boards, the results might be in some respects even worse than if the council itself had full control of the inception, planning and execution of public works. This, as will readily be understood, was due to the division of responsibility and to the control over these boards which would be held by the council so long as it had any voice in their appointment. The expedient of having the executive boards selected by still a third body, such as some law court, or elected by popular vote, also had the disadvantage of divided responsibility. Gradually, therefore, the ideal American municipal government demanded a mayor as an executive head, with the power of appointing and removing all appointed as distinguished from elected officials, and with a greater or less veto power over the acts of the council. Relatively few cities have been willing to go the whole figure and give the mayor absolute power of appointment and removal. Still more rarely has the mayor been given absolute veto power. Yet this ideal of the separation of the legislative functions, with its resultant elevation of the mayor to a place of great dignity and responsibility, was becoming well established in the United States at the close of the 19th century.

Strange to say, a great national catastrophe was the cause of setting for a time, if not actually turning, the current in another direction. This was the great flood at Galveston in 1900. Just how good or bad the city government of Galveston was before the tidal flood wrought the disaster so fresh in the minds of our readers, we cannot say. The presumption is that it was bad rather than good. In any event, the problem of rehabilitating the city, both physically and financially, was such as to convince the people of Galveston of the necessity of devising something more efficient than the ordinary American city government. Hence arose what is now known as the commission plan of city government, which has since aroused great interest throughout the country, and has been adopted by a number of municipalities. This Galveston or commission plan really had as its prototype the commission system under which the District of Columbia has been administered; but the parallel is by no means as close as has been commonly asserted in discussions of this subject, inasmuch as the Congress of the United States is the legislative body for the District of Columbia, and some executive functions, also, are exercised by the United States government.

At Galveston and in the later cities that have adopted the commission plan, five men, generally called the council—the mayor being included as one of the five—are vested with both legislative and executive functions, and, broadly speaking, have full and supreme control of the municipal government. Each of the five councilmen—except in cases where the mayor is excluded from so acting—is made the head of a great municipal executive department, such as public works, health or finance. The council as a whole passes ordinances for the regulation of all city affairs, creates loans, formulates appropriation bills, appoints executive officers, and directs the whole of the activities of the city, with the exception, as a rule, that the board of education or similar body is largely independent of the council, although depending upon it for appropriations.

How far this experiment of the commission plan of city government will go in the United States would be an interesting subject for speculation. It is obviously quite in line with the assertion which has been made with growing frequency of late, that the affairs of a city can be best administered if the city is considered as being in effect a great corporation, with each citizen or voter a stockholder, and with the city council and mayor as a board of directors and president, respectively. There are those, and we believe among deep thinkers there are many, who consider that although this conception of municipal government contains much of truth and force, yet it is nevertheless wholly inadequate to serve the wants of the citizens. The objections that such people would offer relate not so much to the plan as an ideal as to its more practical aspects. They have in mind, doubtless, that the ignorance in which the stockholder of the aver-

age company is kept concerning the real affairs of the company, as well as the absolutism of the directors, is scarcely a condition that one would like to see copied in municipal government. Looking at the matter from this point of view, the first question that occurs to one is, whether any safeguards, preferably automatic in working, can be provided for the purpose of giving citizens virtual control of the five men whom under this plan they choose as directors and president of the municipal corporation. Without attempting to answer so large a question at this time let us see what has been attempted in this direction.

The original or Galveston commission seems to have had little in the way of statutory requirements to hold it responsible to the people. It is true that with only five men in charge of the affairs of the municipality, responsibility can be fixed much more definitely than is possible where there exist a mayor and two councilmanic bodies, besides various other more or less independent executive boards and department heads. Under the latter conditions, as has been proved over and over again in hundreds of American cities, it is very difficult to fix responsibility with any clearness and when it is fixed it is also difficult to remedy the evils which have occurred, or, if punishment be deserved, to make the punishment fit the crime. But with all the concentration and clearness of responsibility incident to five councilmen, what is to prevent them from becoming a highly autocratic or even despotic body, if only they can by some means control a majority at each election?

This question, or others pointing in the same direction, seems to have occurred to charter framers in other cities as soon as serious propositions were made to copy the Galveston or commission plan. Accordingly we find in the Des Moines charter certain provisions designed to give the voters a considerable measure of control over their commission. And a charter recently adopted at Berkeley, Cal., seems to include about everything that is humanly possible in the way of charter provisions for highly concentrated representative government and clearly-cut responsibility, on the one hand, and, on the other hand, for the retention of popular control both of the legislative and executive officials elected by the people and of the very power of legislation itself. In addition to all this, the people of Berkeley have the power, which has for some years been vested in California municipalities, to frame and amend their own charters. This power frees them in large measure from that necessity of continual appeal to the Legislature and that certainty of legislative meddling which is and always has been the great bane of municipal government in the United States.

Elsewhere we present an epitome of the Berkeley charter. We also give in this issue a summary of a proposed charter for New York City, which has been framed with great care and deliberation by a charter revision commission. This proposed charter, although for the largest city in the country, may still be compared in many respects with the Berkeley charter, which is for a comparatively small city, for the purpose of contrasting the two forms of American city charter which seem bound to be rivals for adoption in the near future. The Berkeley charter, as we have tried to make plain, is an example of the most advanced type of the small-commission form of government, but with a reservation of great popular power of control. The proposed New York charter is an attempt to set up the ideal of American city government which we have described as having been reached at the close of the last century: namely, a mayor and his appointees in supreme control of all executive matters, and a city council with legislative functions only. In this case, however, there is a marked departure from the ideal, in that the mayor as executive has associated with him a board of estimate and apportionment, the seven other members of which are also elected by the people. This board, although primarily what may be termed an executive financial committee, really exercises legislative functions to some degree, but does this chiefly in formulating details in accordance with charter provisions relating to the plans for certain public improvements, necessary loans therefor, the formulation of all appropriation ordinances, and everything pertaining to franchise grants. The board has no control over appointments of heads of departments by the mayor.

Perhaps a better exemplification of the city charter ideal at the close of the 19th century is suggested by the amendments to the charter of Boston proposed by the Boston Finance Commission. An outline of these amendments is also presented in this issue.

If the proposed amendments to the Boston charter are enacted into law, the result will be perhaps the most complete separation of executive and legislative functions which has ever yet taken place in any city. The mayor would be given absolute power of appointment and removal. This, however, is no more than the mayor of New York already has. There would be no body standing between the mayor and the city council of Boston, as the Board of Estimate and Apportionment now stands between the mayor and city council in New York. The amendments to the Boston charter aim to make more complete and more difficult of evasion the attempts of the charter of 1885 to deprive the council of any power or influence over contract letting or the employment of labor. The mayor of Boston would have absolute veto power over every act of the city council.

Having outlined, though necessarily in a very summary and incomplete fashion, the general status of American city charter ideals at the close of the 19th and beginning of the 20th centuries, and having outlined even more summarily the new Berkeley charter and the proposed new charter legislation for New York and Boston, we will go into somewhat more detailed comparison of some of the leading provisions of the three charters.

The mayor will first be considered. In both New York and Boston the mayor would hold office for four years, as does the mayor of New York under the present charter. But in Boston, toward the end of the mayor's second year of office, the people would vote on the question as to whether or not an election for mayor would be held. This is a modified form of the recall provided in the Berkeley charter, applicable to all elective city officials—a provision which is already in force in other California cities and has within a few weeks been applied to the mayor of Los Angeles, who resigned rather than stand the test of the popular verdict on his conduct of his office. The Berkeley charter fixes the mayor's term of office at two years, subject to recall vote at any time after three months. Further reference to the recall in the Berkeley charter will be made later.

In New York and Boston, all appointments and removals of executive officers subject to appointment rather than election would be made at the pleasure of the respective mayors, without confirmation by the council, with the exception of the Boston school committee. This general provision is already in force in New York, but under the present Boston charter the mayor's appointments are subject to confirmation by a board of aldermen which includes 75 members. In Berkeley, appointments will be made by a majority vote of council, as all appointees would be subject to the recall after three months.

A qualified veto is lodged in the mayor of New York over all ordinances passed by the council, and also over board of estimate resolutions involving the expenditure of money. The mayor of Boston, as already stated, has absolute veto power over every act of council. He is also empowered to originate either ordinances or loan bills. These the council may amend only with the consent of the mayor. Under the Berkeley charter, the mayor has no veto power, as he is simply a member of the council, coordinate in authority with the other councilmen. But through the referendum, the people of Berkeley may veto, as by the initiative they may also originate, legislation.

The small size of the Berkeley council and of similar bodies under the commission plan elsewhere, has already been mentioned. The value of small legislative bodies is recognized in both the New York and Boston amendments. The proposition for New York is to reduce the number of councilmen from 73 paid to 39 unpaid members, elected by districts. The Boston plan is for only nine members, elected at large, to be paid $1,500 a year. This very small council would replace 75 aldermen and 13 councilmen, the former now receiving $1,500 and the latter $300 per year. The pay of the Berkeley councilmen has been fixed at $1,800 per year for the four members elected as such, and $2,400 for the mayor.* The revisers of the New York charter give as a reason for having the councilmen unpaid that this would take away all incentive to seeking the office on account of salary, and tend, with the decrease in numbers, to dignify the position. Further dignity would also be given under the proposed changes by an increase in the legislative powers of the New York council. As to continuing the compensation in the case of members of the Boston council, it may be remarked that more work would perhaps fall upon the Boston than upon the New York council; owing to the fact that the duties and responsibilities of New York councilmen are lessened by the activities of the board of estimate and apportionment.

An exception to the powers of the Boston council as regards contracts should be mentioned. The proposed charter amendments provide that no contract for more than one year for public lighting or for the collection and removal of city refuse shall be made without approval by the council. In matters of public lighting, the Berkeley council is limited to letting contracts for one year, but it should be remembered that the rates of municipal service corporations in California are subject to local control.

The Board of Estimate and Apportionment, a feature of municipal government peculiar to New York, has for some time been growing in importance, at the expense of the city council. It would have been but a short step for the New York Charter Revision Commission to have made the Board of Estimate into a full-fledged Galveston, or Des Moines, or Berkeley commission. Each member of these commissions is a head of an executive department of his city. The comptroller of New York is already head of the finance department. Each of the five borough presidents, instead of being head of a grand executive division of the city government, is now a sort of borough commissioner of sewers, highways and buildings, elected by his respective borough. The charter commission, instead of abolishing the council, giving the board of estimate full legislative powers, and making its several members heads of executive departments, has increased somewhat the importance of the council and has taken away all direct administrative functions from the borough presidents. As proposed, the board will be divided into seven bureaus, one of which will be the Bureau of Public Improvements and Engineering, with a chief known as City Engineer. But none of these bureaus, not even that headed by the city engineer, will plan and supervise the construction of public works. Their sole function will be to systematize and facilitate the multifarious work (largely financial in character) of the board as the "great executive committee of the city."

The present executive duties of the borough presidents, if the new charter is enacted by the legislature, will be vested in a Department of Street Control, the single head of which will be appointed by the mayor. By this change, the mayor of New York would become the supreme executive head of the city, so far as the appointment and removal of administrative officers are concerned. Public-works administration would again be centralized, as under the first charter for Greater New York, and the Board of Estimate and Apportionment would again become, as was the original intention, chiefly a budget and loan-making body. Its control over franchise grants to public-service corporations, over the

*The mayor of New York would receive $25,000 under the proposed new charter; the comptroller, $20,000; president of council, $15,000; five borough presidents, $10,000 each.

city map or street and park plan, and over the choice of sources of water-supply and certain phases of water-works administration, would remain as seeming exceptions, more or less real, to the complete divorce of executive and legislative functions. When analyzed, these exceptions appear to be on the borderland between legislation and administration. In so far as they are administrative, and as such affect various departments, they should evidently come to the central financial executive committee for adjustment.

Two other important matters pertaining to executive departments demand comment. One, common to the charter legislation of the three cities, is the general provision for single-headed executive departments, which is in line with the tendencies of the day and with common-sense and the teachings of experience. The other matter is charter provisions, or lack of provisions, as to qualifications for executive officers. The Berkeley charter leaves this entirely, and the proposed New York charter almost wholly, to the judgment and conscience of the mayor. Not so the Boston charter amendments. One of the strongest pleas made in the able report of the Boston Finance Commission is the imperative need of such reform in municipal government as will put and keep in executive positions men who by education and training are specially fitted to do the work which will fall upon them. As a means to this end the Commission proposes that the mayor shall certify that in his opinion each of his appointees is specially qualified for the duties of his office. Nor does the effort to get fit men stop here. Appointments do not become effective until the civil service commission, after investigation, certifies that the appointees are what the mayor represents them to be. In addition, the Boston appointments must be made regardless of party affiliation and the appointees need not be residents of Boston—a great step in advance to be even seriously proposed for an American city, though long a strong feature of municipal government in Great Britain and Germany.

The New York charter is silent as to the fitness of appointees, save for exceptions that make the general omission of the subject all the more notable. These exceptions are: That the Commissioner of Street Control *may* appoint a consulting engineer, who, in that event, *must* be an expert in sewer and highway matters of ten years professional experience; that other civil engineers in this department must have had three years experience; that the Commissioner of Buildings, and likewise his building superintendent for each borough, must be a competent architect or builder of ten years experience and that the chief building inspector for each borough must be a *practical*, as well as competent, architect and builder of ten years experience.

It is not easy to guess, or do anything more certain than guessing, why professional experience should have been required for appointees to these and not to other offices. They can scarcely have been singled out for charter stipulation and the others left for definition in the administrative code.

The Boston plan of requiring the mayor to certify to the technical or professional fitness of all appointees has much to commend it. Short of this, the whole matter might about as well be left to the mayor of New York as to be mentioned so scantily as it is in the charter. True, there are some advantages in the mere stipulation that the engineer of a department shall really be an engineer—but who would think of stipulating in a charter that the corporation council should be a lawyer?

Having outlined the division of power and responsibility between the great branches of government in the three charters, the question naturally rises, what has become of the old theory of checks and balances, which, until recently, was an almost universal feature of American city charters, and which is still retained in the majority of them? The two-branched council, modeled after the federal and state governments, was designed to safeguard the rights and property of the municipal citizen, and as time went on a further safeguard was attempted, where it did not exist, in the veto power of the mayor. With the abolition of a second branch of the city council and with the exaltation of the mayor, particularly such exaltation as is proposed by giving him absolute veto power at Boston, what assurances have the public that municipal government will not be made the machinery of municipal corruption, taxation-robbery and personal and political chicanery?

In answer, it may be noted, first, that the checks-and-balance theory was always a delusion and snare, at least as applied to municipal government. Of infinitely more importance is the force of public opinion upon municipal officials, and this can be exerted only by means of definite and clear division of responsibility between different branches of the city government and the possibility of fixing that responsibility upon the individual office-holder. Within reason, the smaller the number of heads of departments, particularly elective heads, the easier it will be to make all office-holders, whether elected or appointed, responsible to the people. Hand-in-hand with clearness in fixing responsibility goes what we may term, for the sake of brevity, intelligent publicity of municipal affairs, and particularly of financial operations and economic results.

As to publicity, it may be noted that the improved accounting measures proposed by the New York and Berkeley charters, both looking to uniformity, are in line with the best modern thought on the subject.

Regarding both accountability and publicity, attention may be called to the means to this end which the New York and Boston charters propose to put in the hands of their respective mayors. We refer first to the commissioner of inquiry to be appointed by the mayor of New York and to be accountable to him only. This officer, with his two deputies, would take the place of the present commissioners of accounts and would conduct investigations of any city department at the instance of the mayor, the scope of the investigation to be wholly within the mayor's control.

Somewhat comparable in general intent, but quite different in origin, would be the finance commission proposed in the amendments to the Boston charter. This commission would be a virtual successor of the Finance Commission which during the past year or two has conducted the exhaustive investigations of Boston finances and other associated matters briefly outlined elsewhere in this issue. It would consist of five well-paid members, appointed by the Governor of Massachusetts, and with power to investigate any and all city affairs. The commission would report from time to time to the mayor, city council, governor or legislature. The mayor would be empowered to refer to the commission any pay-roll, bill or claim against the city. It will be seen that this proposed commission is quite a different affair from the proposed New York commissioner of inquiry and his deputies, who, individually and collectively, would act wholly within the discretion of the mayor. The appointment of the Boston finance commission by the Governor and its power of reporting in its discretion to the governor, to the state legislature, to the city council or to the mayor, would tend far more to a real publicity than could be expected from the New York commissioner of inquiry, subject only to orders from the mayor.

At first thought, the Berkeley commission or council may appear to be vested with autocratic powers and to be entirely beyond public control except at election time. In reality the case is far different. First of all, the mayor and the four members of the council, together with the other elected officials, are always subject to a recall petition (three months after taking office), provided voters equal in number to 20% of the votes cast at the last mayoralty election petition to that effect. A petition signed by 10% of the voters will make any ordinance of the council or any franchise grant subject to popular vote before it becomes effective. Still more, the people may take legislation into their own hands if at any time they see fit, a petition signed by 15% of the voters being all that is required to bring the proposed ordinance to popular vote at a special election, and one signed by 5% of the voters being all that is necessary to secure the initiative, as it is called, in case the proposed ordinance can await action at a regular election.

A still further and, in intention at least, more remarkable attempt to put the city government in the hands of the people from the start, rather than to leave it with political bosses, is contemplated not only at Berkeley but also at Boston. All nominations to elective city offices in each city are to be made, if the Boston amendments carry, by petition. In Berkeley, only 25 signatures are required to nominate a candidate to *any* office. In Boston, with its much larger population, 5,000 signatures are required. The nominations made, when election day comes, the ballot placed in the hands of each voter contains the names of the various candidates without anything whatever to denote party affiliation. Nothing of this sort is proposed in New York City, which, with the remainder of New York State, will have to make a determined struggle if it secures even the modified direct primary system which has been proposed by Governor Hughes.

So much has been said and written of late regarding municipal home rule for cities that a few words on this subject seem demanded. The only gain in this direction proposed by the New York charter amendments—but it is a material one—lies in a reduction in the length and in the detailed provisions of the charter and in the supplementary provision for an administrative code. This code would contain such of the minor provisions of the present charter as it seems necessary to obtain in legislation enacted by the state. In addition, and of great importance, the code would be subject to future revision by the city council. Inasmuch as the code and the charter would contain only some 75,000 words each, or 150,000 in all, as compared with the half-million words in the present charter, and since future charter amendments would apply to a document of only 75,000 words, it can readily be seen what a gain this feature of the proposed charter would be and how greatly it might work to free the city from legislative interference.

The changes in the Boston charter have little bearing, one way or the other, upon municipal home rule, except as they provide a frame of government which possibly would need less legislative reconstruction than has been required in the past. One distinctive gain would be that the proposed Boston amendments would permit the mayor and council of that city to do a considerable amount of consolidating and rearranging of executive departments, which cannot be done now without recourse to the legislature. Like powers of rearrangement of departments, it may be added, are also given in the Berkeley charter.

A remarkable gain in the way of municipal home rule at Berkeley, and one to a large extent common to other California municipalities, is the power enjoyed by the city of framing and amending its own charter.

The Boston Finance Commission, with its proposed appointment by the Governor, does not seem much like municipal home rule. But it is not so far from that idea, or ideal, as may at first sight appear, especially when it is remembered that a permanent, well-paid body of this sort, with members selected for the specific purpose in hand, is much less likely to meddle in local matters than the ordinary legislative committee which may be called into existence at any time under our present American system of legislative interference with municipal affairs. As time goes on, more commissions of this sort may be expected, or, what is probable and would be in many respects preferable, permanent state commissions, with considerable powers of jurisdiction over all the municipalities of the state, may be looked for. Various state commissions in Massachusetts have for many years exercised large measures of control over such matters as water-supply, sewerage, gas and electric lighting and street railways, and but recently the Massachusetts Bureau of Statistics of Labor has begun to collect and publish valuable municipal

statistics. Eventually the work thus begun will doubtless extend in Massachusetts, as it already does in Ohio and has been proposed elsewhere, to state requirements for uniform municipal accounts, with state audit of the same. Such statistics, it should be noted in considering the New York charter amendments, are already provided for in New York State. The Berkeley charter distinctly looks forward to similar state uniformity in California. It should be noted, also, in considering New York charter matters, that the Public Service Commissions of New York State, the State Water Supply Commission and the State Department of Health now exercise large measures of control over a number of municipal affairs and tend to safeguard the public from the neglect and maladministration of municipal officials, besides giving publicity to many of their acts.

Altogether, the charters under discussion, combined with measures of central administrative state control, go a long way toward relieving New York, Boston and Berkeley from legislative interference. When the real nature of municipal government is better grasped by those who so strenuously urge municipal home rule, they will understand that central state administrative control, with the relief which it will afford from continual legislative interference, is the greatest promise of municipal home rule and efficient city government now in sight. Under such central control, the legislature may rest content with establishing general principles of state policy, and leave the central administrative body, composed of experts, to see that these principles and policies are followed. In the past, our great mistake in municipal as in much other legislation has been endless legislation, with little or no provision for the enforcement of the laws.

We have so far outrun the space usually devoted to such discussions that it is impossible to touch upon a number of interesting and important features of these charters. These include measures for the better control of city finances and the granting of municipal franchises. The Berkeley charter is particularly notable for its franchise provisions, and to these we may refer in some future issue.

Altogether, we think it will be evident to our readers, whatever their opinions may be as to the details of the Berkeley charter and the proposed New York and Boston charter amendments, that the changes made and proposed are at least in the right direction. That they will tend greatly to put the municipal engineer and other technical officers in municipal employ in a more permanent and generally more satisfactory position seems to us beyond question.

That these or any other charter provisions will relieve all good citizens from the necessity of exercising discrimination in the selection of their public servants and of constant and intelligent criticism of their official acts is neither to be expected nor desired. The reduction in the number and the increase in the dignity of elected officials, the concentration of responsibility for the appointment of fit officers and for the removal of any that may prove unfit, and the gain in clearness of definition of the duties of various classes of officials, all of which are proposed in greater or less degree by the three charters, combine to promise better things than we have yet seen in American city government—if only the people whom city charters and officials alike are designed to serve prove true to their own interests.

LETTERS TO THE EDITOR.

Engineering: A Profession?

Sir: From time to time, articles have appeared in our engineering periodicals discussing the question whether engineering is really a profession, and whether an engineer is a professional man. An affirmative answer to this question, in view of the limited technical training one receives in our engineering colleges, is very doubtful.

The fault lies with our educational institutions; not one of them pretends to turn out a graduate who can lay claim to having covered even one-quarter of the field really embraced by the term "engineering."

If engineering is to be recognized as a profession, there should be but one course, leading to a degree of Engineering—as with Law, Medicine and Architecture—and this course should cover civil, mechanical, and electrical, and all other artificial branches of engineering. Certain studies should be elective so that a student may plunge more deeply into some branches than into others, but a proper groundwork in all should be required. Then, and not until then, will the engineer be placed upon the same footing as men in other professions.

Very truly yours,
Albert I. Frye.

220 Broadway, New York, March 12, 1909.

[And yet American engineering schools are the best in the world—they give their graduates the best preparation for their life. There are engineers who are certainly professional men. There are others whose work is wholly commercial; and no hard and fast line can be drawn between the two classes of engineers. The business of the engineering school is not to make engineers. Only experience can do that. It is to lay broad foundations on which the youth can build and develop into a useful member of society in either the professional or the commercial field.—Ed.]

Lichen Is Not Moss.

Sir: In your issue of Feb. 25, p. 215, I find the sentence: "—— the typical plant growth of the sub-Arctic region is moss."

This plant, though generally known as "reindeer-moss," is not a moss but a lichen. In "La Maout and Decaisne's Botany" (translation) it is called "reindeer-lichen." Webster (1900) gives "reindeer-moss; a lichen ——," etc. Of course a technical journal cannot be expected to be infallible in all science, but the statement quoted is misleading and incorrect.

Yours very respectfully
Ferdinand Ward Haasis.

78 Seminary Ave., Rahway, N. J., March 17, 1909.

More Concerning the Pay of Engineers.

Sir: We have read with much interest the complaint of "Three Year Old" in Engineering News of March 4, and your reply thereto. Were the facts as you state in this comment, the complaint would be entirely uncalled for, but from information in our possession, we think your position on this question is not consistent with the facts. It is true that the embryo engineer should serve his apprenticeship, and if he could be assured of more substantial returns at the end of five years, you would probably be correct. He certainly looks for substantial recompense, but does he get it? A casual glance at the payrolls of the engineering departments of various railroads, private, and public corporations, and many of the municipalities, shows at once that a technical graduate having ten years' experience may consider himself fortunate if he receives $1,800 per annum. Many of the important positions, carrying with them responsibility requiring ability and education are remunerated with the magnificent sum of $100 per month "while employed." In the files of the "Harvard Engineering Journal," you will find tabulated the average salaries of the engineering graduates of the Massachusetts Institute of Technology, one of the recognized technical schools, for various periods of apprenticeship and practice. This is one of the most reliable tabulations on record. It shows conclusively that the average salary of the engineer, even after ten years' experience, is little if any more than the mechanic whom he has to direct on the work. This condition is general throughout the country, and while discouraging, it may be well to inquire as to the causes of same, and the remedies therefor.

First, the tendency on the part of engineers, as soon as they attain a position of authority, to keep down the salary of the engineering force on the plea of economy, not forgetting however, to give themselves as much as they possibly can.

Secondly, because of the entire lack of any cooperation between the engineers throughout the country, making them subject to every whim of the powers in charge, and putting them in a poorer position to protect their own interests than the ordinary day laborer. This lack of cooperation and organization among engineers results from so-called "Ethics of the Profession," a code of ethics which is very fine in theory, but in practice has resulted in more harm to the economic standing of the profession than if we had no code at all. It is about time that engineers dropped all false ideas and theories, and worked together for the advancement of the profession economically as well as scientifically, and it is for this purpose that the Technical League has been formed. The growth of the League has been rapid, and there is no reason why engineers all associated for this common end could not obtain a more just recompense for the responsible and important work they are called upon to do. There is no question if this were done that the scale of salaries for engineers could be increased two-fold without injustice to any one. Engineering News could, if it wished, render valuable aid in this work of organization. Very respectfully,

J. J. Smith.

Care Technical League, Park Row Building, N. Y. City, March 13, 1909.

Plans for Grade Crossing Abolition at Foxboro and Mansfield, Mass.

Sir: Proceedings are now under way before a special commission, and upon petition of the New York, New Haven & Hartford R. R. Co., for the separation of grades at all the remaining grade crossings on the Providence Division main line, of that company, between Boston and the Rhode Island line. In connection with this work the railroad company contemplates four-tracking the entire main line, and extensive grade changes in the town of Sharon and Mansfield, Mass. The magnitude of the work involved, and the high cost of the same, have aroused all the municipal and state authorities, and raised legal questions as to the extent to which grade crossing abolition can be carried, under the Massachusetts laws.

The statutes provide that, upon petition to the Superior Court by municipal authorities, interested street railway, railroad company, or the state, stating the opinion that

it is necessary for the security and convenience of the public that an alteration should be so made in such crossing, in the approaches thereto, in the location of the railroad or public or private way, or in the grades thereof, as to avoid a crossing at grade, or that such crossing should be discontinued with or without building a new way in substitution therefor,

the court shall appoint a commission of three disinterested persons which shall decide the manner in which the separation shall be effected, the method of doing the work, and apportion the cost between the railroad company, the town in which the work lies, and the state. Street railway companies may be assessed an amount not exceeding 15% of the cost. In all the cases herein described no street railway is involved.

A petition as above, was duly made early in 1907, and a commission appointed consisting of Hon. Samuel L. Powers, City Solicitor Taft, of Springfield, and William Jackson, M. Am. Soc. C. E., City Engineer of Boston. Several hearings were held and views taken, in the spring of that year, but, for several reasons, the matter has lain dormant until December, 1908, when the hearings were resumed.

The crossings in question number thirteen; of which three, Green Lodge St. in Westwood, Dedham Road in Canton, and Elm St. in Mansfield, are to be separated by the simple expedient of raising the street grade to a height sufficient to clear the tracks, bridging the same, and grading gravel approaches. The plan proposed for Summer St., in Foxboro, was the same, but the town petitioned for the discontinuance of that part of the street which crosses the tracks, asking in substitution therefor, the building of a section of new street, about a mile in length. The town authorities claim a saving of several thousand dollars by their plan, but a decision has not been rendered by the commission. Cocasset St., in Foxboro, and in the center of the village of East Foxboro, is to be relocated so as to cross the railroad at a point adapted for a satisfactory and economical passing of the street under the railroad. The remainder of the crossings are in the towns of Sharon or Mansfield and in one or the other of the sections in which changes of grade of the railroad are proposed.

Fig. 1 is a profile of the railroad through part of Sharon, and shows the present grade of the tracks by the full ground line, while the dash line represents the proposed grade. The highest summit between Boston and Providence is at station 650, on this profile, and casual inspection will show the great advantage of securing this improvement. The estimate submitted by the railroad for this work amounts to $544,435. If such proves to be the actual cost, the town of Sharon may be called upon, under the law, to pay a part, not exceeding 10%, or $54,443.50, which is over 2% of the total valuation of assessed estates of the town. The portion which the state may be called upon to pay, is at least 25% of the cost, and whatever part of the 10% is not assessed upon the town, the railroad company paying 65% in any case.

The commonwealth, through the attorney-general, has appeared in opposition to the plan proposed for Sharon, claiming that the plan is really one of valuable grade revision of the railroad and that the separation of grades of the crossings is merely a minor incidental. It is claimed that the cost of the work, if so much is to be done, should be apportioned upon the basis of what the cost would be if the railroad grade were to remain unchanged, and the extra two tracks were not to be added. The state engineer of grade crossings, H. W. Hayes, M. Am. Soc. C. E., prepared a plan and estimate by which the three crossings involved could be separated for a total cost of approximately $104,000, which the

state claims should be the basis of cost apportionment.

The profile, Fig. 1, shows the location of the three streets, Depot St., Garden St. and Mohawk St. Besides these there are two streets, Maskwonicut and South Main, which now cross the railroad on overhead bridges, which will have to be rebuilt to allow the two additional tracks. It is proposed to raise the grade of the streets to be changed, enough to clear the new grade of the track.

The central part of Sharon, and the business center, is near Sharon Station, but at an elevation about 100 ft. higher. On this account the receipt of freight at Sharon Station is impracticable, and the freight station for the town is at Sharon Heights, whence an easier haul into the town is had. The disadvantage to Sharon if the

jected to, in every case, as too narrow and too steep. At Green Lodge St. and Dedham Road, the Neponset River is within a short distance of the crossing, and changes in the bridges will be required. The towns ask that the grades of the river bridges shall be level, as the expense of plank renewals on a 5% grade has been found to be excessive. As Green Lodge St. lies within the Neponset River Reservation, the Metropolitan Park Commission enters the proceedings with certain aesthetic requirements.

Considerable discussion has been heard regarding the justice of the present law by which the public is obliged to bear part of the expense, many people claiming that the railroads should bear it all, but it is not the present purpose to touch upon that question. The writer has, however, compiled certain statistics regarding train

Interest, 6% on $400,000 ..... $24,000
Depreciation, 2.567% on $400,000 10,366

Total $34,366

The community would therefore be th... tiner to the extent of $6,310 by this method of figuri...

It is of course true that when the tim... ame for replacing the property the owners would ... but $400,000 to do it with. There would be no lo... however, as the plant was worth no more at the begin... of the new period. There is certainly no reason ... the community should pay rates which would ...nhance the value of the company's property 50% in ... years. The figures last named take care of the present ...lue. When the time comes for replacement there wo... be no injustice in asking the owners to provide ... additional

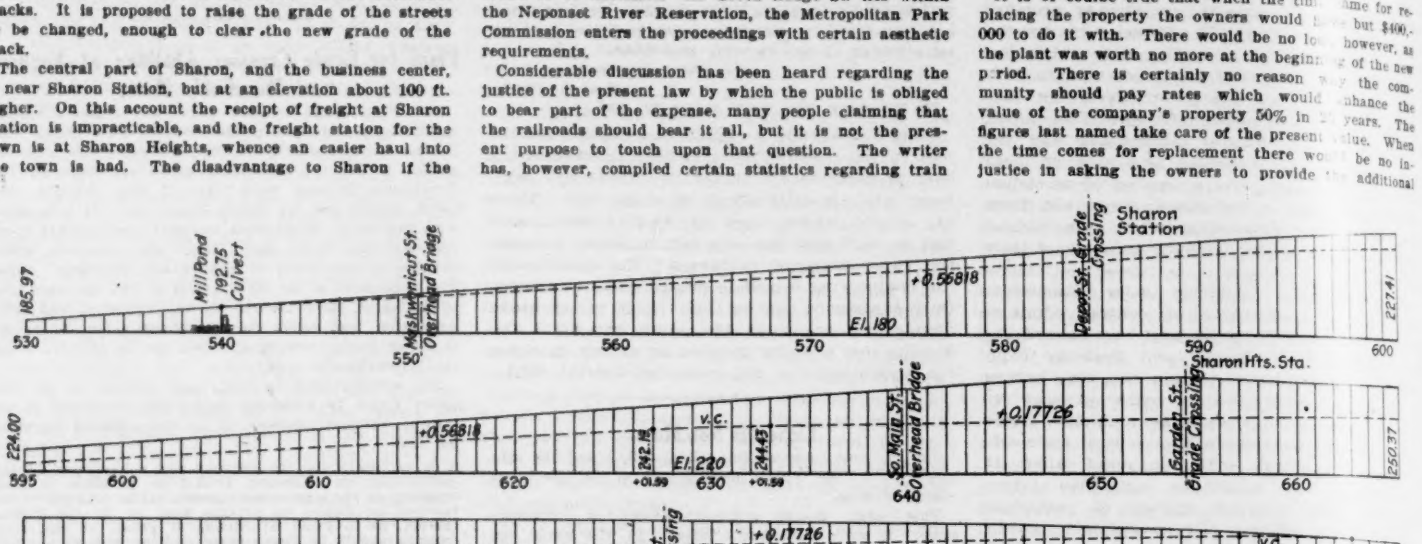

FIG. 1. PROFILE OF PROPOSED CHANGES OF GRADE, N. Y., N. H. & H. R. R., AT FOXBORO, MASS.

Sharon Heights station is lowered 22 ft., as proposed, is thus evident, and the town claims that the damage sustained should offset any assessment on the cost of the work.

Fig. 2 is a profile of the portion to be changed in the town of Mansfield with existing grade shown by full line, and the proposed grade by dash line. Starting from station 885, just over the line in Foxboro, the grade is to be carried on the level until it has passed over the relocation of the tracks of the Taunton Branch; thence it is to drop on a grade of 0.475 to station 130.

The main line at Mansfield is crossed at grade by the through trains operating from Lowell to Taunton over the South Framingham Branch on the north, and the Taunton Branch on the south. Trains from Boston to Taunton are now switched off the main line a short distance east of Mansfield Station, and on the southerly side. By the new plan it is proposed to carry the switches to a point about 1,200 ft. easterly of the station, and lead the branch tracks off on the northerly side of the main line. Thence by a descending grade

movements since the opening of the road in 1835. These, gathered from old newspaper files, files of old Pathfinders, and present time-tables, show an increased use by the railroad of the track over the crossings, from year to year, from two passenger trains a day in 1835 on a steadily ascending rate to 74 daily passenger trains in 1909.

Yours truly,

Fred J. Wood, M. Am. Soc. C. E.

Foxboro, Mass., Feb. 17, 1900.

Provision for Depreciation by Public Utility Corporations.

Sir: While I agree with you as to the propriety and fairness of the Supreme Court's decision in the Knoxville water case, there is, nevertheless, much food for thought in Mr. Winslow's letter in your issue of March 4. It is true that according to the best authorities a public utility which has maintained a sinking fund to cover depreciation would seem to be entitled to higher rates

$200,000 necessary. Having bettered the plant to that extent they would be justified in asking such higher rates as would then take care of the greater investment.

There are good reasons why rates may fairly be lowered when a readjustment is made on the basis of present values. It is certainly better financiering to use the sinking fund to pay off the bonded indebtedness and thereby stop the payment of 6% interest, instead of continuing that payment while the sinking fund is maturing at a much lower rate—usually about 3½%. Such use of the sinking fund permits a continual charging off of the original investment, thus reducing fixed charges, as shown above.

What happens then if new boilers, machinery, or standpipe, etc., are needed to replace worn out apparatus, when the sinking fund has been exhausted in retiring bonds? The value of the plant at that moment is represented by the remaining outstanding bonds, and if the depreciation account has been properly kept, the worn out parts appear at a very low figure—if at all—in the total. Evidently then, such replacements as are then

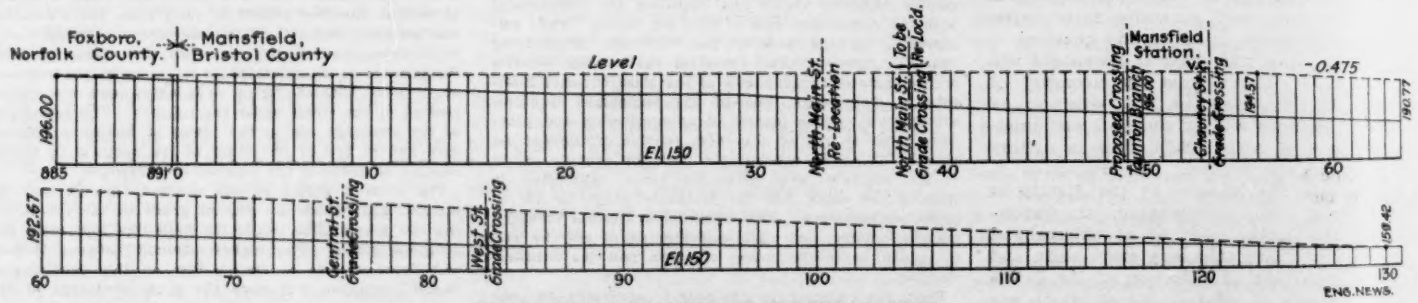

FIG 2. GRADE CHANGES AT MANSFIELD, MASS.

they will be carried around, and under the main line at station 49, as shown on Fig. 2, this crossing serving also to pass the through trains over both branches. The streets crossed within the distance to be changed, will all remain at their present grades, the track being carried high enough to clear them, with the exception of North Main St., which is to be relocated.

The estimate for this work amounts to $875,117, of which the town's share may be, as already explained, $87,511. The prospect of having to assume such a heavy expense, amounting to over 3% of the total assessed valuation of the town, has aroused the people of Mansfield, and they are making strenuous exertions to arouse the people of the state, that the present law may be repealed. It is proper to add, however, that, in the recent reopening of the hearings, the case of Mansfield was not included, and that part of the proceedings appears to be dormant.

In each case of a street to be raised and carried over the tracks, the railroad proposes a roadway 20 ft. "between fences" and 5% approach grades. This is ob-

at any intermediate date than one which had neglected such a provision, even though the latter is prepared to deduct from its reproduction cost an amount equivalent to the accumulations of such a fund, to get present value. Take Mr. Winslow's own figures, a water plant of a reproductive value of $600,000, and a present value of $400,000—which is approximately equivalent to a plant 25 years of age which has maintained a sinking fund of .763 of 1% per annum compounded annually at 3½%. In fixing rates the company having a depreciation fund would seem to be entitled to earn, in addition to operating expense, annual fixed charges as follows:

Interest, say 6% on $600,000	$36,000
Sinking Fund to cover depreciation	4,578
Total	$40,578

If, however, no sinking fund has been maintained, rates should be fixed on the present value of $400,000, and on the assumption that this amount must be repaid in the remaining life of the plant, say 25 years. The fixed charges would then be:

made are really betterments, exactly as if the mains were extended, or new reservoirs built. Such betterments justify higher rates from that date on, to cover increased interest and depreciation charges. Under the Wisconsin law—which, in my judgment, represents our most advanced practice in this field—such rates would unquestionably be allowed upon hearing before the Railroad Commission. If at the time of rate fixing it is evident that extensive betterments must be made in the near future, the rates could be fixed with that in mind.

I am not able to follow Mr. Winslow as to the two differing values which such a property may have—the selling and the rental value. The authorities are a unit on the proposition that rates must be based upon the then physical value of the plant, which is now universally accepted to mean its reproduction cost less depreciation. Mr. Winslow's illustrations seem hardly apropos. The rental value of a house or of a horse both certainly decrease with age.

In the consideration of such problems it must be remembered that such replacement is never in gross, at

any one particular date, but is always piecemeal. Also that many companies which keep no separate depreciation account do what amounts to the same thing by making extensions and improvements which equal—and often exceed—the depreciation.

Attention is called to the plan now advocated by a number of engineers, of not starting the depreciation account until some years after the beginning of operation of the new plant. This plan—which I believe is being used in the case of the new Cincinnati water-works—has much to commend it. As a matter of fact the actual depreciation is practically nil during the earlier years, and furthermore the earnings are not—and cannot be made to be—commensurate with the depreciation, as such plants must always be built in advance of present needs.

William H. Bryan,
Consulting Engineer.

315-316 Lincoln Trust Building, St. Louis, Mo., March 6th, 1909.

A Proposed New Charter for New York City.

When New York, Brooklyn and a score or so of other municipalities were merged in a Greater New York, on Jan. 1, 1898, the charter which was to serve as a governmental guide was confessedly a patchwork. A few years later the charter was reenacted, with various amendments. Some of the amendments were fundamental, such as those decentralizing much of the public-works administration, and others were designed merely to remedy minor defects. The charter was still largely an agglomeration, rather than a well-formulated scheme of city government.

Two charter commissions have recently taken a hand in trying to bring the New York charter more thoroughly into line with the needs of the city and with the best present-day conceptions of what the charter of a great American city should be. The first commission reported Dec. 1, 1907, but merely analyzed conditions and made recommendations for amendments. The second commission, appointed by the Governor in April, 1908, has recently made its report and has submitted the draft of a bill for a new charter. Eight of the fifteen members of the new commission had served on the earlier one. The new commission was organized with Mr. William M. Ivins as chairman, E. R. S. Gould as vice-chairman and James C. Meyers as secretary. Mr. H. A. Metz, Comptroller of New York City, and Mr. George Cromwell, President of the Borough of Richmond, were also members of the second commission.

The commission states that few fundamental changes are included in the proposed new charter. The object of the commission was to condense and clarify the old charter, and at the same time to make a sharper separation than before between the fundamentals of the city government and its administrative details. It submits a charter containing the fundamentals, and will later submit an administrative code composed of matters which are subject to more change than the fundamentals. The code would be subject to revision by the City Council, but the charter could be amended only by legislative action. The charter and the code each consist of about 75,000 words, or 150,000 altogether, as compared with 500,000 words in the old charter.

In brief, the scheme of government proposed is a relatively small unpaid council, with strictly legislative functions; a much smaller "financial executive committee," consisting essentially of the present Board of Estimate and Apportionment, but with some changes in powers, duties and internal organization; and an administrative department headed by the mayor, with enlarged powers and including 18 administrative departments, mostly single-headed.

It is proposed to pay the mayor $25,000 a year, the president of the city council—who also exercises the functions of a vice-mayor, on occasion—$15,000, the comptroller, $20,000, and the five borough presidents, $10,000 each. These eight officials, as at present, would form the Board of Estimate and Apportionment.

The borough presidents, each of whom is now virtually a commissioner of public works, would no longer have administrative powers or duties.

The city council would consist of 39 members, against 73 at present, and would be elected by districts. The council would have nothing whatever to do with the granting of franchises, the letting of contracts or the issuing of bonds. The budget, or yearly appropriation bill formulated by the board of estimate and apportionment, would be submitted to the council for approval or disapproval; or for reduction, but not for the increase, of separate items. Any changes in the budget made by the council, or disapproval of the whole budget, could be vetoed by the mayor, and in that event a three-fourths vote of the council would be required to override the veto.

The heads of city departments would continue, as now, to have seats in the city council without vote.

The mayor would appoint and remove at pleasure all heads of departments and nearly all the members of commissions or boards. These appointments would not go to the council for approval. The mayor would also appoint an advisory board to act with the board of estimate and apportionment, "in devising and formulating plans for the comprehensive development and improvement of streets and parks."

Another appointment by the mayor would be a commissioner of inquiry. This commissioner, with the approval of the mayor, would appoint two deputies, one of whom would be an attorney. The commissioner and deputies would comprise a "bureau of examination in the mayor's office," and would take the place of the present Commissioners of Accounts. The charter provides that these three officials "shall" investigate the affairs of city officers and departments, and report to the mayor; but the mayor is given "exclusive discretion and power to determine the scope of any such investigation."

Each of the 18 administrative departments except those having to do with health, education, parks and hospitals, would be single-headed.

The board of estimate and apportionment, which, in the language of the Charter Commission, would be the "great financial executive committee of the city," would have under its jurisdiction seven bureaus: Public Improvements and Engineering; Franchises; Real Estate; Claims; Salaries; Statistics and Publicity; and Supplies. The head of the Bureau of Public Improvement and Engineering would be known as the city engineer, and would have to be a resident of the city, with at least ten years' professional experience.

Among the powers of the board of estimate and apportionment the following are of particular interest to engineers: The power to change the map or plan of the city so as to lay out new parks, streets, bridges and tunnels; the power to select all sources of water-supply; the power to cause meters of a pattern and price to be approved by it to be placed on any or all consumers. It would also be the duty of the board to establish standards for any class of supplies needed by any city department, and to require all specifications for contract letting to be uniform, so far as practicable. Another important duty of the board would be to prescribe the forms of all city accounts, and to ensure uniformity.

It may be noted in passing that the mayor, president of the council and comptroller would have three votes each in the board of estimate and apportionment; the presidents of the boroughs of Manhattan and the Bronx, two votes each; and the presidents of the other three boroughs, one vote each.

The heads of the various administrative departments, except as provided by law, would have the power of appointing and removing employees.

The health department would include the health commissioner, the chief of police, and the health officer of the port; but the health commissioner would be chief executive officer of the department, and (apparently) the other two officials named would seldom act in conjunction with the commissioner. It would be the duty of the health department "to take all steps necessary to the sanitary supervision of the water-supply of the city and the sources thereof." The health department would also exercise legislative functions to the extent of revising and adding to the sanitary code.

The park department would be composed of three commissioners. One of these would represent Manhattan and Richmond boroughs, one Brooklyn and Queens boroughs, and one the Bronx. Generally speaking, each commissioner would have jurisdiction in the boroughs he represented.

The department of water-supply would be divested of its present jurisdiction over certain matters pertaining to gas and electric lighting, which would be turned over to the department of street control. Among other things, it would be the duty of the department of water-supply to maintain the quality of the supply; to make such regulations regarding the use of water as may be authorized by the administrative code or by ordinances of council; and, subject to the board of estimate and apportionment, to fix a "uniform scale of rents and charges for water supplied by the city." Besides maintaining the quality of the supply as mentioned above, the charter provides that the department of water-supply shall preserve the purity of sources of supply. It is also provided that all sources of water-supply "shall be subject to such sanitary regulations as the State Board of Health may prescribe."

The aqueduct commission would be abolished and its duties vested in the commissioner of water-supply.

Perhaps the most notable feature of the proposed charter is the establishment of a department of street control, with bureaus of street cleaning, highways, sewers, gas and electricity, public buildings, and encumbrances. The commissioner of this department, when authorized by the board of estimate and apportionment, might employ a consulting engineer, "who shall be expert in all matters relating to sewers and highways, and shall have had ten years' professional experience." All other civil engineers appointed by this commissioner are required to have had three years' professional experience.

The bridge department seems to be left substantially as it exists under the present charter, unless it be that it is authorized to construct tunnels (excepting such tunnels as come under the Rapid Transit Act) beneath navigable waters, with terminals in two separate boroughs.

A creation, or recreation, of the proposed charter is a building department. The commissioner of this department must be a competent architect or builder of at least ten years' experience. He would have control of the construction, removal and alteration of all buildings except those appertaining to docks, bridges, tunnels and subways, but could not grant certificates relating to the construction or alteration of tenement houses until there had been filed with him the proper certificate from the tenement house commissioner. There would be a bureau of buildings in each borough, with a superintendent of buildings in charge under control of the commission. These superintendents would have to be possessed of qualifications like those prescribed for the commissioner. There would be a chief inspector of buildings for each borough, appointed by the commissioner. Each of these officials would have to be a "practical and competent architect, builder, or engineer," of at least ten years' experience.

Each of the five boroughs comprising the city would under the new charter become a local improvement district for all improvements the cost of which is met by assessments for benefits. The president and council members of each borough would compose the several local boards, except when the proposed improvements would extend beyond more than one borough, when the membership would be increased accordingly. These local boards would have the power of initiating proceedings for constructing tunnels, bridges, sewers, streets, and for the acquisition of property therefor and for parks; and they would have the power, if approved by the board of estimate and apportionment, to authorize and direct, by resolution, the proper department to execute the proposed improvements. The ap-

proval of the board of estimate and apportionment would not be required for individual improvements costing under $5,000 each. The total expenditure which would be carried out in each borough under these local boards would be fixed in January of each year by the board of estimate and apportionment.

The Art Commission, which has been in existence for a number of years past, would be continued. The Board of Education, as created in 1897, would be abolished and a new board of 15 members created. The board of education would no longer be a separate corporate body. It would have power to enact by-laws, etc., and to construct school buildings; but the rental of property for school purposes, it appears, would be under the jurisdiction of the board of estimate and apportionment, which would act upon recommendations made by the board of education. Provision is made for 39 local school boards, or one for each council district. These boards would have five members each, two of whom would be women. The members of the local boards would be appointed by the board of education, and would have the powers and duties prescribed by the administrative code.

A New and Interesting Charter for Berkeley, Cal.

Municipal home rule to the extent of framing their own charters has been the privilege of California cities for some years past. The general procedure is to elect by popular vote a board of freeholders to frame a charter. On completion, the charter framed by these freeholders is submitted to popular vote. If approved, the charter goes to the State Legislature for ratification. All this is done in accordance with Section 8, Article XI., of the State Constitution.

The city of Berkeley has recently framed and adopted a charter in accordance with the plan just outlined. Fifteen freeholders, including Mr. Benjamin Ide Wheeler, President of the University of California, were elected on Nov. 21. Although the constitution permits a period of 90 days for framing the charter, the Berkeley instrument was submitted on Dec. 14, or a little over three weeks after the election. Perhaps some preliminary work had been done, but as to this we cannot say. The charter was approved by popular vote on Jan. 30, the vote being 5 to 1. On the same date an alternative substitute clause providing for prohibition instead of for the licensing of saloons, was adopted by a vote of 4 to 1.

The leading features of the charter are: The so-called commission plan of government; the recall of elective officials; the initiative and referendum. In addition, the charter contains many other interesting provisions, as may be seen from the following outline:

All nominations to elective offices are made by petition only, by filing with the city clerk 25 certificates of nomination, each signed by one voter. There is no limit to the number of candidates for any given office. If at the regular municipal election any office is not filled then a secondary election must be held three weeks later. At primary elections the candidates receiving the highest number of votes for the several offices in question shall be deemed elected, provided that number "is greater than one-half the number of ballots cast at such election." In case of any non-elections, then, as far as unfilled offices are concerned, the regular election becomes a primary and the two candidates who received the highest number of votes (or three in case of a tie) become the nominees to be voted on at the secondary election.

An election to vote on the recall of any elected official may be brought about by a petition signed by qualified electors equal in number to 20% of the last mayoralty vote. This petition may ask for either a special election or for a vote on the recall at the next general election. Unless the officer sought to be recalled resigns within five days of filing the petition, then it is the duty of the council to call an election as requested. The published notice of a recall election must set forth, within the limits of 200 words, the reasons for the recall, and the officer in question may also use an equal number of words for his own defense. At these recall elections, the official in question shall be considered a candidate unless he has already resigned, and in addition other candidates may be presented, exactly the same as in any other election. No recall petition shall be filed within three months after the official has taken office, and no person who is recalled, or who resigns after the filing of a recall petition, shall be appointed to any office within a year thereafter.

There are only ten elective offices under the new Berkeley charter. These are a mayor, an auditor, four councilmen and four school directors. Both the council and the board of education, however, have five members, the mayor serves as a councilman, and that one of the four men elected as councilmen who is, subsequently selected as commissioner of finance and revenue, becomes a member of the board of education. All five members of each body have the right to vote. The ten officials just named are elected on a general ticket from the city at large.

The mayor and auditor hold office for two years, the councilmen and school directors for four years; but provision is made for so arranging the terms of the first incumbents of the office that only two drop out of each body at the end of each two years.

The salary of the mayor is fixed at $2,400 and that of the auditor and the four councilmen at $1,800 each; but the school directors are to receive $5 each for each regular meeting of the board of education which they attend, but not more than $15 in any one month.

The mayor is made the chief executive officer of the city, with oversight of all departments of the government. It is his duty to employ at the beginning of each fiscal year a certified public accountant, who shall examine at least twice during the year all the "books, records and reports of the auditor and of all officers and employees who receive or disburse city moneys." This accountant is given "unlimited privilege of investigation, to examine under oath or otherwise all officers, clerks and employes of the city." It is also the duty of the mayor to supervise all public-service corporations.

The four members of the council other than the mayor are each to head one of the following departments: Finance and Revenue; Public Health and Safety; Public Works; Public Supplies. The councilmen to fill these respective offices are to be chosen by a majority vote of the council at its first meeting after an election. Changes in the headship of departments may be made by the council at any time it is deemed that "the public service will be benefited thereby."

The appointive officers named in the charter are city clerk, assessor, treasurer, collector, attorney, engineer, chief of police, fire chief, street superintendent, health officer and five library trustees. These officials are to be appointed and may be removed by majority vote of the council. The council may consolidate these offices if it sees fit. Other positions may be created and filled by the council in its discretion. Religious or political opinions, affiliations or services are not to be taken into account in the appointment of officials.

In the absence of any one of the four commissioners named as heads of the councilmanic departments,

no final action shall be taken in any matter concerning the special department of any absent councilman unless such business has been made a special order of the day by action at a previous meeting of the council, or such action is taken at a regular meeting of the council.

The council is given very broad general powers for the acquisition, by purchase, condemnation or otherwise, of a great variety of public buildings, works and institutions, including baths, abattoirs, farm schools, quarries, wharves, docks, waterways and canals. The council also has power to acquire in like manner water, light, heat, power, telephone, telegraph and transportation facilities, the latter including "electric or other railways, ferries and transportation service of any kind." Provision is made for joint ownership of water-supply with other municipalities.

Under the general heading of "Powers of the Council," it is specifically stated, in addition to provisions elsewhere for the initiative, that

the qualified voters of the city shall have power through the initiative and otherwise, as provided by this charter and the general laws of the state, to enact appropriate legislation to carry out and enforce all of the above general powers of the city or any of the specified powers of the council.

A number of commissions are provided for by the charter, including civil service, civic art, park, playground, and public utilities. The members of these commissions will serve without compensation. The council is also specifically authorized

to provide a suitable procedure for taking over or otherwise acquiring municipal ownership of public utilities.

A careful method of procedure is outlined for all matters pertaining to departmental estimates and the annual budget of the city. Estimates originate with the heads of the various departments, who report them to the commissioner of finance and revenue. This official submits the estimates to the council, and this body in turn prepares the annual budget and of course makes provision for the tax levy.

The tax rate is limited to $1 on $100 of assessed valuation, except that the council has power to collect taxes in addition sufficient for interest and sinking fund on bonded indebtedness, and to provide for the establishment and support of free public libraries and reading rooms. Not less than 35 cts. of the $1 tax rate shall be apportioned to the school fund unless the board of education calls for a less amount.

A notable feature of the charter is an attempt to put the city on a cash basis. This is so unique that we quote the section, as follows:

The council shall create and maintain a permanent revolving fund, to be known as the Cash Basis Fund, for the purpose of putting the payment of the running expenses of the city on a cash basis. For this purpose the council shall provide that, from the money collected from the annual tax levy and from money received from other sources, a sum equal to not less than 2½ cts. on each $100 of the assessed value of said property shall be placed in such fund until the accumulated amount in such fund shall be sufficient to meet all legal demands against the treasury for the first four months or other necessary period of the succeeding fiscal year.

The council shall have power to transfer from the cash basis fund to any other fund or funds such sum or sums as may be required for the purpose of placing such fund or funds, as nearly as possible, on a cash basis. It shall be the duty of the council to provide that all money so transferred from the cash basis fund be returned thereto before the end of the fiscal year.

Another notable section of the charter is the one relating to uniform accounts and reports, as follows:

The council shall prescribe uniform forms of accounts, which shall be observed by all officers and departments of the city which receive or disburse moneys. Whenever an act shall be passed by the State Legislature calling for uniform municipal reports, the city authorities shall be governed thereby.

The matter of letting contracts of various kinds and of granting franchises is dealt with in considerable detail in the charter. Contracts for public lighting are limited to a year. An eight-hour day shall not be exceeded by laborers, whether employed by the city or by contractors.

The franchise grants are made subject to public bidding. Advertisements of such grants must outline the character of the service and provide an upset price of not less than 2% of the gross annual receipts during the first ten years, 3% during the second ten years, 4% for the third, and 5% for the remainder of the life of the franchise. Bids for franchise grants must be presented sealed. After such bids are opened, "any responsible person, firm or corporation," present or represented, may bid above the highest bidder not less than ¼ of 1% of the gross annual receipts, and any such bid as this may be raised by ¼ of 1% until the franchise is struck off to the highest bidder. The life of all franchises is limited to 35 years. Every franchise, whether it so states or not, shall carry with it the right of the city to regulate rates to be charged by the recipient, but the franchise shall also provide for purchase by the city of the works involved, at a fair valuation, but with no allowance for the value of the franchise itself. Or, as an alternative, the franchise grant may provide that the ownership of the property shall be vested in the city, without compensation to the company, at the expiration of the grant. On whatever basis the franchise may provide for city ownership, no document of conveyance would be necessary when the city assumed ownership. All franchises for street railway purposes shall provide that the recipient "shall sprinkle, clean, keep in repair, and pave and repave" all the

portion of the street between the tracks and for two feet outside of the tracks of the company. The charter also makes provision for the audit of the books of any franchise companies by the city, and for written annual reports to the city by the company, the reports to be in forms prescribed by the city. These reports shall state the gross receipts of the company, and such other information relating to the receipts, expenses and business of the company as the council may see fit to demand.

Full provision is made for the initiative and referendum, under which a comparatively limited number of voters, on petition, may either initiate legislation on their own account, or may bring any ordinance passed by the council to popular vote.

The initiative may be brought into effect by submitting a desired ordinance to the council, accompanied by a petition signed by either 15% or between 5 and 15% of the number of electors voting at the last mayoralty election. In case the council does not see fit to pass such a popular ordinance within 20 days after the certification of the petition as to legality by the city clerk, then the council must submit an ordinance to popular vote. A special election must be called on a 15% petition, if the petition so requests. A 5% petition only serves to bring a proposed ordinance to vote at the next general election. No alteration in a popular ordinance shall be made by the council. Only one special election for voting on popular ordinances shall be held within any six-month period, but any number of popular ordinances may be voted on at one election. Popular ordinances may be amended or repealed only by popular vote.

Referendum votes may be called for on all council ordinances, within 30 days of their passage, save for exceptions which need not be noted here. To secure a referendum vote a petition signed by electors equal in number to the last mayoralty vote is required. On receipt of such a petition the council must reconsider the proposed ordinance, and either withdraw it or else submit it to popular vote, at a general or a special election. The council may of its own motion submit ordinances to popular vote.

As regards the nomination of candidates and the election of mayor, auditor, councilmen and school directors, the charter becomes effective immediately on approval by the legislature; in all other particulars it will take effect on July 1, 1909.

The population of Berkeley was 13,214 in 1900.

The Report and Proposed Charter Amendments of the Boston Finance Commission.

A highly gratifying recognition of the value of the services of the engineer and other trained technical men is shown by the report of the Boston Finance Commission, which was submitted to the Massachusetts legislature a few weeks ago. This recognition includes the employment of engineers to assist the Commission in its work* and recommendations for charter amendments as to the technical qualifications of departmental heads. The whole report of the Commission abounds with comments on the causes of inefficiency of municipal government and suggestions for greater efficiency.

The Boston Finance Commission was created in 1907 by the city council of Boston, at the instance of a new mayor, and was given state powers and duties by subsequent legislative acts. Mr. Nathan Matthews, an ex-mayor of Boston, served as chairman of the Commission.

Appointed to consider the financial condition of Boston, the Commission has found it necessary or desirable to investigate nearly every phase of the city government, and in concluding its labors it has submitted a draft of what it considers to be much-needed amendments to the city charter. We shall attempt to give some idea of the nature of the Commission's report and shall epitomize the proposed charter amendments.

The report opens with an interesting historical review of the charters and government of Boston. The present condition of the city government, which is generally unsatisfactory, and its causes are next considered, after which "The Remedy" is discussed. The remedy consists, chiefly, in a further definition and separation of the powers and duties of the city council and the executive departments, respectively, and in the creation of a permanent finance or investigating commission. Particularly notable features of the remedy are propositions to make appointments and removals of executive heads by the mayor absolutely independent of the council, and to give the mayor absolute veto power over the acts of the council.

It was not until 1822, and not until after ten unsuccessful attempts to secure a charter, that Boston abandoned the town-meeting form of government. Under its first charter, a mayor and a two-bodied council conducted affairs, much after the then and the present British system. In 1854 the mayor lost some of the small power he had previously had. In 1885, the present charter was enacted. It was a compromise measure, but was a marked advance towards the American system of vesting all or nearly all executive power in the mayor and, as a consequence, confining the council to legislative functions.

The Commission dwells at some length upon the reasons why membership in the Boston city council, under the present charter, is generally held to be "a discredit" to a man and why it is hard "to induce representative men to become candidates for either branch." The Commission does not attribute this to the fact that the council has been stripped of executive functions. Instead, it believes that only by such stripping is "membership in the city council possible for busy men." And it adds that the conduct of the council and its members explains why "competent and representative citizens are disinclined to serve in it." This conduct includes lack of "serious consideration" to councilmanic duties, log-rolling in connection with loan bills, domination by spoilsmen and continuous attempts to evade those provisions of the 1885 charter which were designed to prevent councilmen from having any interest whatever in city contracts or purchases or in the employment of labor. Much petty work is done by the councilmen which "could be done much better and quicker by the executive departments." Summing up, the Commission says:

> It is clear that the city council as now constituted is too large and cumbersome a body for effective action, that the term of office is too short, that it has too much work of minor importance to do, and that the mode of nomination is prohibitive of the best results.

Coming next to the executive departments, the Commission states that it found too many of these for efficient work, and that some of the departments had been created "for the purpose of furnishing high-salaried offices, which could be filled without recourse to the civil service lists." Just prior to the creation of the Commission, appointments had been made as a reward of services rendered the mayor or to further his "political and personal fortunes." Even when men selected for office have been efficient and capable, "they have been practically without professional or technical knowledge or experience." Moreover, most of the department heads are appointed for one year only, and their appointments are subject to confirmation by the board of aldermen. While the 75 councilmen have no power of confirmation of executive officials, yet "their importunities on the whole may be even more effective than those of the aldermen." The report continues:

> The position of the head of a department under the present form of government, subject to intimidation from one man who has the power to remove him, from 13 men who may refuse to confirm his reappointment, and from 75 others who have the power officially and publicly to abuse him, without opportunity for reply, is intolerable. Young men, graduates of the Institute of Technology and other similar institutions, who ought to constitute one of the classes from which the heads of departments could be chosen, are advised by their instructors not to enter the city's service; and in the case of the salaried officers, it is as difficult for a well-meaning mayor to secure efficient heads of departments as it is for the people to induce competent and disinterested citizens to stand for the city council.
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> The result of these conditions, which had been gradually growing worse, was that there had been a steady deterioration in the technical competency and moral strength of the heads of the executive departments, until at the time when this investigation was ordered the administrative business of this great city was, so far at least as the salaried heads of departments went, with a few notable exceptions, in the hands either of men without education, training, experience, or technical qualifications of any sort, or of men who had become so demoralized by the conditions which surrounded them as to be unwilling to protest against the most obvious extravagance and graft, if favored by the mayor.
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> One of the most discouraging facts noted was the passive acquiescence, during the period under discussion, of the city engineer, the schoolhouse commission, the health commissioners, the water commissioner, the fire commissioner and the law department, in transactions which they knew involved a waste of city money.
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> The members of boards who give a portion of their time, often considerable, to the service of the city, without compensation, are not subject to the temptation which the occupation of a salaried office offers, and have generally not permitted themselves to mismanage the business entrusted to them under intimidation by the city council or dictation by the mayor. The influence of the spoils system, however, was rapidly making itself felt in these departments also; and the danger of independence was vividly illustrated by the case of the pauper institution's trustees, who were removed from office in 1907 because they had the courage to refuse to retain an unfit superintendent in the face of the mayor's determination to keep him.

The efficiency of the labor force in the employ of the city had declined steadily in recent years, until 1907, when "the amount of work done for the city per man per day was only half as much as it had been prior to 1895." In the same period, the number of city employees had increased from 8,630 to 13,753. This is an increase of 59%, or 2½ times the increase in population. In the same twelve years, the clerical force had increased at an even greater rate, or a total of 75%, and the salaries paid the clerical force were greater than those paid in Boston for similar work by the state and federal governments. These increases in pay-rolls and salaries had been made for political purposes, and for like reasons

> all pretense of discipline in the larger departments had been abandoned. Incompetency, drunkenness and insubordination were seldom visited by suspension, still less frequently by discharge.

Under such conditions it is not surprising to read that the Commission found the cost of various classes of public work in gross had been greatly increased over what it properly should have been. For instance, the report states that

> in twelve years the loss due to the operations in crushing stone by the day labor force of the paving division was at least $1,000,000.
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> Between 1902 and 1906 the paving division lost $70,000 under contracts for bitulithic pavements, given without competition, at nearly 50% in excess of a fair competitive price. For ordinary asphalt pavements the city paid, under contracts awarded without competition, the uniform price of $2.50 per sq. yd.—nearly 2½ times what was paid in New York, and at least 75 cts. above the fair cost of such pavements in this city under competition.

One of the most discouraging disclosures of the whole investigation by the Commission is embodied in the following sentence:

> Reputable business houses, including some of the largest corporations in the country, conspired to defraud the city, descending in some instances to the acceptance of such petty sums as $300, $200 and $150 as their share of the plunder.

Various specific examples of such minor plundering are given. These are followed by an interesting story of the "Boston Agreement," entered into about 1900. This was "a carefully planned combination" which embraced "practically all the firms and corporations engaged in structural steel work in New England." We regret to say that the methods of such combinations are so well known to our readers that it is unnecessary to give further space to this one.

It was in the years 1906-1907 that conditions in Boston reached their worst. In these years it is estimated by the experts employed by the Commission that losses of $1,900,000 were caused in the street cleaning and watering, sanitary, sewer, water and paving departments of the city.

*Vol. III. of the report of the commission will consist of 63 reports, condensed, by Messrs. Metcalf & Eddy, of Boston, and of 14 reports by Mr. Samuel Whinery, of New York. These reports deal with water-works, sewers, street paving and street cleaning.

through unnecessarily large numbers of employees and the performance by day labor of work that should have been done by contract. The attempts to secure competition during this period were either abandoned or became a farce. Thus, the report states:

> In the public grounds department a collusive competition for the construction of certain walks on the common was held for the benefit of an influential member of the board of aldermen, contracting in another person's name. The mayor and city engineer were parties to the transaction in the sense of having had sufficient knowledge of the facts to have stopped it had they seen fit. Six other contracts for connecting walks were subsequently given to the same person without any pretense of competition, the work having been split into separate jobs to avoid advertisement. The city engineer said that the work was perfectly simple, and that there was no reason for not inviting competition by advertisement; but he did not consider it his duty to volunteer advice, and he prepared the papers without protest.
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> The same alderman procured, under another business alias, a contract from the penal institutions department, for the construction of a wall on Deer Island, which involved about $50,000, and a loss to the city of $10,000. There was at first some pretense of competition, but ultimately the contract was awarded to the alderman's company on private terms. The penal institutions commissioner and the city engineer were practically ordered by the mayor to make this contract. It was an improvident contract for the city, and an improper one for any city official to sign; yet the city engineer drew it and the commissioner signed it at the instance of the mayor, who in writing first dispensed with competition and then approved the contract. The supervision of this contract was as free from any genuine regard for the city's interest as its origin. There was no effective inspection, and over-payments were systematically made to the contractor until they were stopped by a report of this commission. Neither the commissioner nor the engineer made any proper efforts to check the false accounts rendered by the contractor. Each claims to have assumed that the other was attending to this duty. As a matter of fact neither discharged it.

As to the inefficiency of labor, one specific example may be cited. The average number of bricks laid by the sewer department force "in the week most productive of results was only 115, the general average was 50, and it dropped on one job to 4" per hr. In the same period, masons employed by the Metropolitan Water and Sewerage Board were laying an average of 224 bricks per hr., while under a job done by contract for the city of Boston the average was 242.

The reports made by the engineers to the Commission, we understand, set forth vast amounts of evidence quite as damaging to the city government of Boston for 1906-1907 as that cited above.

Under such conditions, although of course not to be wholly attributed to the causes specified, the increase in the city debt of Boston from 1895 to 1907 totaled over $67,000,000. This was at the rate of 170%, or four times the increase in the preceding ten years. The per capita debt for the same period increased from $79 to $175, or 120%. The ratio of debt to property valuations increased from 4.1 to 8.1, or 96%.

Commenting on these and similar facts, the Commission, in one of its many interim reports, said:

> There seems to be no intelligent cooperation between the city council and the heads of departments with reference to loans. Sometimes the heads of departments are not consulted at all; sometimes their opinion is received, but ignored; and in some cases loans are voted for purposes which, in the opinion of the department, are distinctly objectionable.
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> No community can thrive under the load of a debt which is piling up four times as fast as its wealth, and 7½ times as fast as its population.

The remedies suggested for such a state of affairs are expressed, in so far as they can be reduced to such terms, in the charter amendments submitted by the Commission. Numerous reforms have been made without awaiting the proposed amendments, but, the Commission states, the continuance of these depends "upon the good will and courage of the mayor for the time being," while in the exercise of those qualities he is hampered and opposed in a variety of ways that can be easily imagined. In order to put such reforms as have been accomplished on a permanent basis and to make other reforms possible, the Commission considers necessary the charter amendments proposed. Before deciding on these, the Commission considered various plans which have been suggested. Before passing to the specific plans, it referred briefly to charter legislation for other American cities and to foreign experience in municipal government. It noted the fact that abroad the executive power is exercised in large degree by elective bodies, and that nowhere is there found any such concentration of power in the mayor as we are accustomed to in the United States. Summing up its few brief remarks on foreign experience, the Commission says:

> In all these countries the municipal departments appear to be in charge of competent trained experts who are expected to retain office so long as willing and able.
>
> The main lessons to be derived from the administration of foriegn cities are the utility of a more effective supervision by the central government, the importance of trusting the administration to experts, and the possibility, as shown by the experience of France, of eliminating the spoils system from democratic institutions.

We can touch only briefly upon the various "remedies considered but not adopted." The "Greater Boston plan" was not considered promising, in view of the results of consolidation of various adjoining municipalities in the case of Greater New York and the Administrative County of London. At the same time, it is interesting to note, the Commission expresses its opinion that eventually the Boston Metropolitan District "will be converted into a single municipality." It adds that "reform should precede enlargement."

The elective-commission plan "presents many advantages" to "small cities suffering under the rule of committee government." The plan thus far has been confined to small cities, and it is too early to draw conclusions from their experience. Inasmuch as successful business corporations "are practically managed by one man under the supervision of the directors," and since no large American city has shown a disposition to entrust its government to an elective commission and "no one with experience in the city government of Boston has favored" the adoption of the commission system for that city, the Finance Commission dismissed it from consideration.

One of the fundamental difficulties in the administration of large cities is that "too much is required of universal suffrage." That is, the voter has to express his choice for "so many officers that it is impossible for him to ascertain the qualifications of the candidates." This doubtless was one of the controlling reasons why the Finance Commission recommended the substitution of the city council of nine members for the present two-bodied council consisting of 75 aldermen and 13 councilmen.

The Commission summarizes its conclusions as to needed changes in the form of government, and then summarizes its proposed charter amendments as follows:

> (1) A simplified ballot, with as few names thereon as possible.
> (2) The abolition of party nominations.
> (3) A city council consisting of a single small body elected at large.
> (4) The concentration of executive power and responsibility in the mayor.
> (5) The administration of the departments by trained experts, or persons with special qualifications for the office.
> (6) Full publicity secured through a permanent finance commission.

The Proposed Charter Amendments.

Taking up some of these propositions in more detail, we may first note that under the proposed charter amendments the mayor would be elected to serve four years, but before his second year of office had been concluded the voters of Boston would decide by popular vote whether or not there should be an election for mayor. If the vote were in the negative, the mayor would serve out the four-year term; but if in the affirmative, another election would be held, at which, we suppose, the mayor then in office might, if he chose, be a candidate.

The city council would be composed of only nine members, each elected at large to serve three years. They would be paid $1,500 a year, but would not be allowed to receive any other sum from the city treasury. The 13 Boston aldermen, it may be added, have received the salary just named since 1888, and the 75 councilmen have been paid $300 each since 1896.

Under the proposed Boston charter amendments, the councilmen would be [illegible]ly excluded from taking part or having a[illegible]financial interests in city contracts, the p[illegible]ase of supplies or real estate, the employm[illegible]of labor, the construction, alteration or repai[illegible]any public works or buildings, and, in gene[illegible]they would be excluded from taking any par[illegible]the executive or administrative business of [illegible]city or in the appointment or removal of [illegible]municipal employee. An exception to the [illegible]nitation on taking part in contracts is made [illegible]the effect that no contract for public lighti[illegible]or for the collection, removal and disposal o[illegible]ity wastes, would become effective unless ap[illegible]ed by the council.

Ordinances and loan bills would be originated by either the mayor or the city council. Such ordinances and loan bills as originated with the mayor would be subject to adoption or rejection by the council within 60 days. They might be amended with the consent of the mayor. All appropriations from sources other than loans must originate with the mayor, who must submit a budget to the city council annually. The council could reduce or omit any item included in the mayor's budget, but could not add to or increase any item. Department heads would be required to submit yearly estimates to the mayor for his use in making up the budget.

The mayor would have absolute veto over every "appropriation and every other act, order, resolution and vote of council." Items providing for the expenditure of money could be vetoed by the mayor in whole or in part.

Perhaps the most striking charter reform yet officially proposed for a large city is the abolition of all primaries and caucuses for selection of municipal officials. Nominations would be solely by petitions signed by at least 5,000 voters, the petitions to be accompanied by the acceptance of the nominee. The names of all nominees would be printed on official ballots without party designations. At the election a plurality vote would decide.

The executive department of the city under the proposed charter amendments would for the most part remain as now, but the mayor and council would be empowered to rearrange or diminish departments at will but not to increase the number. This permissive power would not apply to the existing building and fire departments, or to certain other departments of no particular interest to our readers, or to the departments in charge of officials appointed by the Governor.

All heads of departments and members of boards, exclusive of members of the school committee and of officials appointed by the Governor, would be appointed by the mayor without confirmation of the council.

A notable provision of this portion of the proposed legislation is that all appointees

> shall be recognized experts in such work as may devolve upon the incumbents of said offices, or persons specially fitted by education, training and experience to perform the same, and [excepting election commissioners] shall be appointed without regard to party affiliation *or to residence at the time of appointment* [italics ours.—Ed.].

The mayor must certify to the qualifications of each appointee and that the appointment is made "solely in the city's interest." Before the appointments become effective the Civil Service Commission must also certify to the qualification of the appointees, first having made careful inquiry "under such rules as they may establish with the consent of the Governor and council" [as to the rules]. If the Civil Service Commission does not file such a certificate with the city clerk within 30 days from the receipt of the notice of appointment from the city clerk, then the appointment is void.

No change is made in the tenure of office of the members of boards, but heads of departments would serve for four years and would "continue thereafter to hold office during the pleasure of the mayor." The mayor may remove any of his appointees by filing with the city clerk a written statement giving specific reasons therefor and sending a copy of the statement to the person affected. The official removed would have the privilege of filing an answer to the removal statement with the city

clerk, but the answer would not in any way affect the action of the mayor unless he chose to be influenced by it.

Provision is made for a finance commission of five members, the powers and duties of which would be somewhat similar to those which were held by the temporary finance commission.

The members of the finance commission would be qualified voters of the city of Boston, but would not be appointed by any branch of the city government. They would be chosen by the Governor of Massachusetts, with the advice and consent of the [state] council, and would be subject to removal for cause by the appointing power. The members of the commission would serve a period of five years. The chairman would receive a salary of $5,000 a year and the other members $3,000 a year each.

The duty of the finance commission would be to investigate any and all city affairs that needed investigating, and to report on the same from time to time to the mayor, the city council, the governor or the legislature.

The mayor would be empowered to refer to the finance commission any "pay-roll, bill or other claim against the city" the validity of which seemed to him questionable. Pending the results of such investigation, which should be made immediately, payment would be withheld. The finance commission would have authority to employ such experts, counsel and other assistants, and to incur such other expense, as might be necessary up to a total outlay of $25,000 per year (not including salaries), or including any additional sum appropriated for the purpose by the mayor and the council.

Some miscellaneous provisions of the proposed amendments may be noted. Bonded debts incurred by the city after the proposed legislation went into effect would be paid in annual instalments without sinking funds.

Officials who knowingly exceeded the appropriations of their departments would be criminally liable. The construction of new or the alteration of old buildings, involving an expense of more than $1,000, would have to be carried out under five contracts, after advertisement in the City Record, unless on filing the written reasons therefor the mayor authorized otherwise.

A City Record would be established, to be published weekly under the direction of the mayor. In it, public advertisements would appear of all contracts or bond sales, and also lists of all contract awards exceeding $1,000, with the names of bidders and the amounts of bids. There would also be published lists of appointments by the mayor, and the proceedings of the city council and the school committee.

The jurisdiction now exercised by the aldermen over various uses of streets which require permits would be transferred to the street commissioners. Such permits, when granted by the street commissioners, would be subject to the written approval of the mayor. The mayor and city council would, however, fix by ordinance, in general terms and once for all, the fees or rentals for these permits.

The land takings for city purposes would follow in general the present eminent-domain proceedings for park lands, but whenever the price proposed to be paid was 25% in excess of the average assessed valuation for the past three years then the land, instead of being taken by private agremeent, would be secured by condemnation proceedings. No land takings would be legal until the appropriation therefor had been made by the mayor and city council, and such appropriations would require a two-thirds vote of all the members of the council.

In conclusion, the proposed act provides that, in so far as it relates to nominations, it would take effect on Oct. 1, 1909. As regards the finance commission it would take effect immediately, and in all other particulars it would go into effect on Jan. 1, 1910.

A CIVIC CENTER PARK for Denver Colo., opposite the state capitol, is proposed. The scheme was originally suggested by Mr. Charles Mulford Robinson, of Rochester, N. Y., in a report submitted to the Mayor of Denver in January, 1906. Since then the plan has met with the approval of a special committee and of various local organizations.

Annual Convention of the American Railway Engineering and Maintenance-of-Way Association.

The tenth annual meeting was held Jan. 16 to 18 at the Auditorium Hotel, Chicago, and was successful in every way. The attendance was unusually large, 335 members and guests being registered.

The program was a long one, there being 24 committees, all but five of which had reports to present. Several of these reports were very voluminous. Abstracts of some of the most important are given on other pages of this issue. Owing to the immense amount of material presented no attempt was made in the discussions to consider anything beyond the conclusions or recommendations of the committees, with the result that many important matters were passed without notice.

In the three days of the convention there were seven long business sessions, an evening session being held on the first day. All of these were largely attended. The annual dinner was held on the evening of the second day. At the evening session, an hour was set aside for memorial addresses relative to the two members who have died during the year: the late Walter G. Berg and D. D. Carothers.

On March 19, the day following the convention, there was an excursion by special train to Gary, Ind., to view the great steel works of the Indiana Steel Co., which are now approaching completion. The rail mill was seen in operation. On the way, stops were made to visit the works of the Universal Portland Cement Co., and the roundhouse and yards of the Chicago, Lake Shore & Eastern Ry.

The usual exhibition of railway materials and appliances was for the first time held in a separate building, having grown beyond the limit of the hotel accommodation. It was held at the Coliseum, and made a very good display.

The opening address was delivered by Mr. Wm. McNab, who was made President in May last to fill the vacancy caused by the death of the late Walter G. Berg. The report of the secretary and treasurer showed a membership of 784, and a cash balance of $16,147. The officers for the present year are as follows: President, William McNab, Principal Assistant Engineer of the Grand Trunk Ry.; Vice-Presidents, L. C. Fritch, Consulting Engineer of the Illinois Central Ry., and W. C. Cushing, Chief Engineer of Maintenance of Way of the Pennsylvania Lines (Southwest System); Treasurer, W. S. Dawley, Chief Engineer of the Missouri & North Arkansas Ry.; Secretary, E. H. Fritch, 962 Monadnock Block, Chicago.

With this brief review of the general proceedings, we turn to a summary of the several reports and discussions.

Roadway.

The report of this committee was brief, but was accompanied by extended appendices dealing with three specific subjects: (1) track elevation and depression for the elimination of grade crossings (with a review of the laws of several states and the ordinances and practice of a number of cities); (2) the prevention and treatment of slides and washouts, with particulars as to the individual practice and experience on a number of railways; (3) the size of waterways for stream crossings, with a review of various methods and a series of statements from individual engineers. The discussion was very limited, but it was the opinion that the conclusions presented by the committee were too general in regard to the important matter of slides and washouts. Mr. J. A. Atwood (P. & L. E. Ry.) suggested that reference should be made to preserving the toe line of embankments subject to wash by floods.

Ballasting.

This report presented an extended review of methods and materials for ballasting track, particulars of which we shall publish later. It described tests made by the U. S. Department of Agriculture (Office of Public Roads) on the physical properties of different kinds of stone; these included tests for abrasion, hardness, impact and cementation. On the basis of the results, the committee showed that a saving in the quantity of stone and in the expense of lining and surfacing track way be effected by the use of tough trap rock instead of a softer rock. In view of the increasing use of screened or washed gravel, when the sizes of particles to be accepted or rejected are of importance, the committee recommended sizes as follows: (1) "gravel," particles that will pass a 2½-in. ring and be retained upon a No. 10 screen; (2) "sand," particles finer than gravel which will be retained on a No. 50 screen. It also recommended certain limiting proportions of sand and dust in gravel ballast for first and second class track.

The discussion turned entirely upon gravel ballast, and the proportions of sand, dust and pebbles therein. The committee's suggestions were not accepted, and the report was referred back to it. Mr. W. Beahan (L. S. & M. S. Ry.) stated that washing was made necessary by clay in the gravel. Clean sand could be removed by screening. He also pointed out that gravel contains not only pebbles and sand, but also a fine impalpable dust. The large proportion of this last is not generally recognized, but it is the dust and not the sand proper that forms the clouds of dust following fast trains.

Ties.

The committee presented revised forms of blanks for statistical records of ties and tie renewals, and an appendix gave brief descriptions of a number of steel and concrete ties. The report made recommendations as follows: (1) the use of chemically treated ties; (2) the protection of ties against mechanical wear; (3) the enforcement of specifications and the exclusion of small ties; (4) the prevention of forest fires; (5) the encouragement of reforestation and the revision of tax laws by legislation which will make it possible to hold lands with growing timber for the purpose of future tie or timber production. Under the present system, the destruction of timber is encouraged and its restoration is discouraged. Mr. Wendt (P. & L. E. Ry.) remarked that in France and Germany the forest administration system produces a revenue besides maintaining a permanent supply of timber. Mr. C. S. Churchill (N. & W. Ry.) referred to foreign methods of forestry. The committee's conclusions as to steel and concrete ties were adopted, with some modifications as follows:

> An improved form of steel tie of the I-beam type, with metal plate over the insulating fiber and with wedge-clip rail fastenings, seems to be very promising.
>
> No form of reinforced-concrete has been made which is suitable for heavy and high-speed traffic, but a properly reinforced-concrete tie with proper fastenings may be found economical in places where speed is slow and where conditions are specially adverse to the life of wood or metal.

The committee specially referred to tie-plates and screw spikes as means of preventing mechanical wear of ties, but unfortunately this was not sustained and the report made rather vague and colorless by simply recommending that ties be protected against such wear. Mr. W. C. Cushing (Pennsylvania Lines) and some other speakers thought that the reference to screw spikes should be omitted in view of certain reports of unsatisfactory results, and this action was taken. Had the conclusion been left unchanged it would probably have encouraged the development and introduction of improved fastenings, which is now largely opposed by spike manufacturers. Mr. J. B. Berry (C., R. I. & P. Ry.) said that in experiments with screw spikes several failures had been reported, but investigation showed that these were all due to improper placing of the spikes.

As to ties treated by the zinc-chloride process, Mr. H. R. Safford (Ill. Cen. Ry.) has found that with such ties the length of track-circuit sections must be reduced, the metallic preservative in the ties tending to short-circuit the current. The length may be increased after a few years, but never to the length used where untreated ties are laid. Mr. A. H. Rudd (Pennsylvania Ry.) remarked that while the above is the case with wooden ties treated in this way, steel ties also are liable to cause trouble owing to the difficulty of keeping the insulation effi-

cient. Mr. J. A. Atwood replied that the Pittsburg & Lake Erie Ry. has had 3,000 I-beam steel ties in use in main track for two years, without causing any trouble in the track circuits. These ties, with their insulation were illustrated in our issue of Dec. 24, 1908. Mr. Wendt (P. & L. E. Ry.) referred to an experiment with steel ties and wooden ties on adjacent miles of the same main track. The trackmen were not allowed to do any surfacing, and after 16 months service the results were very favorable to the stretch of track having steel ties both as regards condition and labor cost. Mr. A. W. Thompson (B. & O. Ry.), however, had had trouble from the slipping of I-beam ties in the ballast, and the damage to ties and rolling stock in cases of derailment.

Wood Preservation.

This is a new committee, taking up work which was formerly in the hands of the committee on ties. Its report presented a general review of the subject, the adaptability of different woods to the treatment, the methods of measuring the absorption of creosote, and specifications for creosote oil. An important feature of the report, supplementing the tie committee's remarks as to screw spikes (noted above) was the following statement.

> The necessity of work upon an improved rail fastening in connection with the use of treated ties is urgent. It is evident from present results that economic life of treated ties cannot be obtained without an improved rail fastening.

In the discussion, Mr. W. W. Curtis referred to the lack of specifications for creosote oil. The specifications submitted by the committee were good, but he doubted the wisdom of adopting them at this time, as their use would exclude practically all American oil and much of the foreign oil. Other speakers objected to the specifications on the ground that they called for oil of an unnecessarily high quality. In regard to the use of the lighter oils, one member suggested that even when these evaporate they leave some good results within the tie. The committee's specifications were finally adopted.

Rails.

As a preliminary to the systematic investigation of rail breakages and failures, the committee has prepared a series of blank forms for uniform reports on rails and rail failures. These include tests and inspection at the mill, details of individual failures, records of rails laid and rail wear, and tabular records of failures covering periods of time and different weights, sections or makes of rails. The report states that the quantitative statistics will show whether failures are decreasing or increasing from year to year, and what particular kinds of failure are the most numerous. The information derived from the study of individual rails will be necessary in determining the causes of different kinds of failures. The investigation would include photographs of the fracture, chemical analyses, physical test, and micro-photographs to show the structure of the metal. The report included specifications for a drop-test machine.

The committee stated that there has not yet been time to secure information as to the results of rails of open-hearth steel or of those rolled to the specifications of the American Railway Association. As to canting or inclining the rails inward, to conform to the slope of the wheel tread (as is done in Europe), 14 railways are experimenting, with varying success, and one is in favor of the plan. Three use tie-plates to cant the rails, the other adze the rail seats of the ties. One road has issued instructions for this in tracklaying, and proposes to cant all its rails. The report was accepted as information, practically without discussion.

Track.

This report covered a diversity of subjects. Among other matters it presented a mathematical discussion of the split switch and the transition curve, with information as to the practice of individual railways in the use of the latter. The tables of frogs and switches were criticised as being too extended, the frogs ranging from No. 4 to No. 24. Some of the members considered that three frog numbers should be sufficient, but they could not agree as to the selection and it was evident that there could be no agreement in this matter by railways in general. Some of the conclusions of the committee were as follows:

> All curves should be spiraled which would require 2 ins. superelevation for the highest speed. The clear width of standard flangeway for all frogs and between main rails and guard rails should be 1¾ ins. (measured at the gage line) for all tracks of standard gage.
>
> Within proper limits, a slight variation of the gage from standard is not seriously objectionable, provided the variation is uniform and constant over long distances. Under ordinary conditions it is not necessary to regage track if the increase in gage has not amounted to more than ½-in., provided such increase is uniform.
>
> Wide gage, due to worn rail, within the safe limits of wear, need not be corrected until the excess over the gage is equal to or exceeds ½-in., it should then be corrected by closing in.

Buildings.

The committee made an enquiry as to coaling stations and coal storage bins of reinforced-concrete construction, but found comparatively few in use. Railway engineers who have built such plants generally regard this type as satisfactory, but are not yet prepared to recommend it on account of increased cost. Comparative estimates indicated a cost 40% higher than with timber, and actual figures increase this to 50%. On the other hand, experience with the new type and the rising price of timber will tend to reduce this difference. Cylindrical storage bins have been used at a power plant, but the designers of railway plants have adhered closely to the general lines of the timber structures. As to reinforced-concrete roundhouses, the committee repeated its recommendations of last year (Engineering News, April 2, 1908) with some modifications, but these did not meet with general approval.

Masonry.

The committee recommended the use of monolithic concrete construction in arches or large abutments with wing-walls, and this recommendation was adopted. It presented (as information only) a lengthy statement on concrete retaining walls and abutments, dealing with the general principles of design, and illustrating a variety of designs, including the buttressed-wall design. The committee presented specifications for Portland cement concrete and reinforced concrete, to take the place of the concrete specifications previously adopted. The specifications were read in full and some clauses were discussed, but very few changes were made. They provide that steel for reinforcement shall be made by the open-hearth process. Some objection was made to a clause providing that briquettes of the cement and fine aggregate (1:3) should show a tensile strength at least 70% of that of similar briquettes made with the same cement and standard sand. Mr. R. L. Humphrey (of the committee) urged this as very important, in view of the growing use of concrete and the necessity of some standard of comparison for the materials to be used.

Wooden Bridges and Buildings.

This report presented specifications for long-leaf yellow-pine timber and for piles, prepared after consultation with manufacturers. In regard to inspection, it was stated that this should be done preferably at the mills. In the discussion on the pile specifications, some speakers thought "cypress" should be qualified to include only certain kinds, but others pointed out that there is no definite distinction and that "red" and "yellow" cypress may be the same. Others favored the inclusion of short-leaf pine, but this also was rejected. On motion of Mr. J. P. Snow (Bos. & Me. Ry.) chestnut was included in the timbers suitable for piles.

A table of unit stresses for timbers was given in the report, and we shall print this later. These stresses are for railway bridges and trestles; they may be increased by 25% for highway bridges, and 50% for buildings or where the timber is protected from the weather and not subjected to impact.

Iron and Steel Structures.

This committee presented a set of rules and instructions governing the maintenance of bridges, including protection from corrosion. It also reported progress as to its impact tests on railway bridges, and the results were briefly presented at the meeting by Prof. Tur[illegible]ure (University of Wisconsin). The tests i[illegible]de plate-girder and pin-connected bridge[illegible]nd also bridges having ballasted floors. [illegible]e 15,000 records have been taken.

Signs, Fences, Cattleguards and [illegible]ossings.

This report dealt with three subje[illegible] (1) the construction of grade crossings ove[illegible]ved and unpaved streets, country roads and [illegible]rivate or farm roads; (2) protection against [illegible]w, with descriptions of different styles of s[illegible] fences, snow sheds and snow plows; (3) co[illegible]te fence posts, as to which some particular[illegible]re given elsewhere. The report made a curi[illegible] mistake in calling a flanger a "small snow-[illegible]ow." As a matter of fact, it may or may not be a snow-plow, and a snow-plow may or may not have a flanger. The flanger is a device to cut snow and ice from the inside of and below the top of the rail head, so as to give a clear passage way for the wheels. As to the width of flangeway at street crossings, the report states "not less than 2 ins." Mr. Stein (C. R. R. of N. J.) says his road uses 2½ ins., and thought the report should add "and not more than 2½ ins." Mr. L. C. Fritch (Ill. Cen. Ry.) thought that other roads might require a wider flangeway, and that it was not desirable to limit it. The report was not changed.

Signaling and Interlocking.

This committee presented a lengthy report, including the following: (1) a form of agreement for the construction, maintenance and use of joint interlocking plants; (2) a revision of the specifications for mechanical interlocking; (3) specifications for electrical interlocking; (4) specifications for rubber-covered wire; a report of the Railway Signaling Association on the protection of drawbridges. The electrical interlocking specifications were accepted, but those for mechanical interlocking were referred back to the committee with instructions to include a specification for wrought-iron pipe. As presented, they included only soft-steel pipe. Mr. A. H. Rudd (for the committee) claimed that wrought-iron pipe of good quality is not to be had, and that even if it is called for, the steel pipe is substituted for it; consequently it was considered better to seek to improve the latter by drawing up specifications as to its quality. Mr. C. H. Ewing (Read. Ry.) stated that good wrought-iron pipe is being produced and should be admissible in interlocking work, in which view the meeting concurred.

The agreement as to joint interlocking plants led to an extended discussion regarding its provisions for the apportionment of the expense of installation, maintenance and operation. There were different opinions as to the methods of apportioning. Some of the speakers also objected to laying down any method; in the first place, it might conflict with certain state laws and existing agreements; in the second place, the matter is not properly within the field of the association. Mr. Rhea (General Electric Co.) thought that a report on this matter would be very acceptable to state railway commissions, but it was suggested that railway companies would give it a less hearty welcome and might not relish action of this kind. The matter was referred back to the committee.

Records, Reports and Accounts.

The report presented a revised form of track chart, with conventional signs as adopted by the association. It recommended the use of double lines for each track on maps of 1 in. to 50 ft. or less, and single lines on those of 1 in. to 200 ft. and 100 ft. For maps of this last scale, however, double lines should be used where necessary to show turnout details, and on maps representing completed work, station plans and permanent records. Forms for time books and for estimates of construction were also presented. As to the latter, the report states as follows:

> Much good can result from the adoption of a uniform method of preparing estimates. Too often such estimates are prepared according to the notions of the individual engineer, and in many instances a failure to have before him in printed form the items that are usually found in work of that character causes him to make omissions.

Uniform Rules.

This report submitted brief formal rules governing the employmen of track, signals, and bridges and buildings. A curious omission is that while the firemen are required to go at once to the scene of accidents, no such clause is provideo in the case for bridge foremen. Mr. Wendt (P. & L. E. Ry.) suggested the advisability of continuing the three sets of practically identical rules in one set, but no action was taken on this. The rules for track foremen provide that at least once a day the foreman must go over his section "or send a reliable man." Mr. Webb (Mich. Cent. Ry.), a member of the committee, objected to giving authority to the foreman to delegate this important work to another man, but there was no discussion on this point.

Water Service.

This report discussed the relative economy of different fuels for pumping stations. The average fuel consumption per effective HP. is found to be 50 lbs. of coal and 0.50 gal. of gasoline; the range is from 30 to 67 lbs. for the former, and from 0.24 to 0.98 gal. for the latter. The committee believes that with plants of the same capacity the labor charge would be the same with either fuel, as a gasoline engine should not be left to run without intelligent supervision. The selection of the coal should be made in accordance with the following conditions:

(1) Coal should be used: (A) where 100 lbs. of coal unloaded into a pump-house is cheaper than 1 gal. of gasoline delivered in a storage tank; (B) where a steam plant is maintained for other purposes, as at terminals where shops are run by steam; (C) where the interest charge on the plant is less than it would be for a gasoline plant.

(2) Gasoline should be used: (A) where I gal. delivered in the storage tank is cheaper than 100 lbs. of coal unloaded into a pump-house; (B) where the quality of the water is such that it will necessitate heavy boiler repairs, provided boiler compounds cannot be used successfuily (C) where the interest charge is less than it would be for a steam plant.

Sources of supply, types of pumping plants, supply pipe lines, and the design of wooden and steel tanks are also considered. It is stated that there has been a considerable development in the use of the latter, and they are recommended by the committee where the character of the water permits. In answer to an enquiry it appeared that the committee had not considered the matter of reinforced-concrete tanks. As to the care and operation of pumping plants, Mr. Loweth and Mr. Clausen (C., M. & St. P. Ry.) stated that this is in some cases attended to by the station agents, who receive extra pay for the work.

Yards and Terminals.

This committee presented an extended report dealing mainly with three important subjects: (1) the operation of hump switching yards, with an appendix giving the details of operation for 28 yards; (2) the design of terminal freight houses and warehouses; (3) the use of freight handling and conveying machinery. An interesting feature was the suggestion of the use of steep grades and cable traction for the ascending side of the hump, to save space and to reduce operating expenses. We shall publish some parts of this report. The report was largely in the way of supplementing and closing of subjects which have been under investigation by the committee for three or four years. It was accepted, practically, without discussion.

General Contract Forms.

This committee submitted a form of general contract intended for agreements or contracts between railways and contractors, together with a list of the several matters to be included in or covered by the contract. It presented the following general statement regarding contracts:

The components of a uniform general contract to be used genrally in connection with construction or engineering operations are two: (A) a proper agreement form; (B) a statement of general conditions applicable to all classes of construction operations.

The agreement form (A) should embody the following:
1. An introductory or opening clause.
2. A complete statement and description of all parties to the agreement.
3. A concise description of the subject-matter; in other words, a description covering the nature and the location of the work to be performed or furnished for a consideration.
4. A statement of when (sometmes under what conditions) the contract becomes operative and the limit, if any, for duration of the contract.
5. A statement of the documents accompanying the contract.
6. A clearly defined statement of the payment or consideration.
7. A proper form of attestation, which should cover the signatures of all the parties to the contract, with necessary seals if required, and witnesses to the signatures, or, when the contract is to be recorded, execution and acknowledgment before a notary public.

The general conditions statement (B) covering the mutual understanding as to the general stipulations of the contract, should embody not only matters which of necessity must exist, but also contingencies that would materially affect the contract, together with provisions covering the procedure in such events.

Flat Spots on Car Wheels.

This special committee was appointed to report on the allowable length of flat spots on car wheels. It reported that it had attended meetings of the wheel committee and arbitration committee of the Master Car Builders' Association. The wheel committee received evidence and statistics, but did not consider that these proved the present limit of length (2½ ins.) to be too great. It therefore declined to change the present M. C. B. limit. The committee on flat spots recommended, however, that the investigation should be continued, in view of the important relation of the matter to the safety of tracks and traffic.

Damage by Brine Dripping from Refrigerator Cars.

This committee made a preliminary report on the injury to signal equipment, bridges and track, stating that this is a factor of importance in maintenance costs due to the shortened life and the more frequent inspection. It referred to reports made at meetings of the Master Car Builders, Signal and Bridge & Building associations. Three methods of relief have been suggested: (1) reservoirs on the cars (objected to by the car owners); (2) drip pipe made to discharge over the middle of the track; (3) waterproof deck on bridges. On the Chicago, Burlington & Quincy Ry., bridge paints last ordinarily about four years, but on lines exposed to refrigerator car traffic only about one year. Estimating the cost of cleaning and painting a floor system at 25 cts. per ft., the additional cost due to the refrigerator cars is about $37,500. This is independent of the injury to the track, which is considerable. The Michigan Central Ry. estimates an additional cost of $145,000 per year to the damage to track, bridges and signals. The committee recommended that the American Railway Association be requested to take such action as will stop the dripping of brine from cars, and this recommendation was approved by the meeting.

Miscellaneous.

Progress was reported by the following committees: (1) Economics of railway location; (2) Electricity for railway traction; (3) Conservation of natural resources; (4) Specifications for cement; (5) Fuels and structural materials (in cooperation with the National Advisory Board).

Notes from Engineering Schools.

UNIVERSITY OF WISCONSIN.—The new forest products laboratory of the U. S. Forest Service will be located at Madison, Wis., in connection with the State University. The establishment of the laboratory here means the concentration of all lines of the experimental investigations of the government in closer and better utilization of timber and in the checking of wood waste. The Forest Service laboratories for timber testing at Yale and Purdue Universities and the wood-pulp and wood-chemistry laboratory in Washington will be consolidated and transferred to Madison as soon as practicable. A force of 15 to 20 timber-test engineers and experts in wood preservation, in wood-pulp manufacture and in wood-distillation will have charge of the work carried on. The laboratory will have an equipment valued at not less than $15,000. The University will furnish the building, light, heat and power and in return advanced students will have the use of the laboratory for special work in related lines.

Offers were made by several institutions for this forest-products laboratory, but the contest ultimately narrowed down among the universities of Michigan, Minnesota and Wisconsin. The choice was based on several factors, such as: (1) building, site and equipment of light, heat and power; (2) courses in instruction in forestry, agriculture, engineering and science generally; (3) general accessibility to the forest regions of the Eastern, Central Valley and Southern states, to the industries most concerned with the work of the laboratory and to the officers of the Forest Service on inspection details; (4) practical research work, especially that done in connection with professional and industrial organizations; (5) relation to State and Federal policies affecting the conservation of natural resources.

THE SUNNYSIDE COAL MINE AT EVANSVILLE, IND., was the scene of an explosion of dust or gas March 20 which resulted in the death of five miners and the injury of 20 others. The five are said to have been killed by sulphuric fumes that followed the explosion, which is ascribed to a "windy" shot. Twenty-nine men were at work in the west shaft of the mine when the explosion took place and that most of them escaped alive is due to the fact that the explosion did not disable the fan.

A GANGWAY FROM H. M. S. "VANGUARD," of the British navy, to the wharf collapsed March 20 at the Vickers Sons & Maxim yard, Barrow-in-Furness, England, and dropped 50 workmen onto the dock. Three were killed and 40 others injured.

A CAVE-IN AT A CUT on the Trans-Continental Ry., 20 miles north of La Tuque, P. Q., Can., March 15, buried six workmen, five of whom were killed.

THE VERDICT ON THE DELMAR WRECK, as submitted by the coroner's jury, ascribed the accident to the Philadelphia, Baltimore & Washington R. R.'s unsystematic management of the yard at Delmar, Md. A report of this accident, in which eight men were killed, was published in these columns Feb. 25, 1909. The verdict concludes with the following statement:

Said wreck in our opinion, according to the evidence, was caused by the unsystematic manner in which the said yard is conducted by the Delaware division of the Philadelphia, Baltimore & Washington R. R. Co.

A FREIGHT LOCOMOTIVE BOILER EXPLODED on the Lehigh Valley R. R., near Corfu, N. Y., March 23, almost instantly killing the engineer and fireman, while the brakeman was severely injured. Reports state that the boiler was split in two and thrown, together with the engine trucks, about 50 ft. from the train, and that four cars were derailed.

A TERMINAL STATION WRECKED BY A TRAIN and six persons killed are the results of a most remarkable railway accident which occurred at Montreal, P. Q., on Wednesday morning, March 17, 1909. The Canadian Pacific Ry. night express train from Boston to Montreal, came into the Windsor Terminal at Montreal out of control, both engineer and fireman having been disabled by escaping steam, and though the emergency brake cord had been pulled by a brakeman when nearing the station the train still had enough momentum to break through the bumping-post and run through the walls of the terminal station. Four persons were killed in the waiting room, and the engineer and another were so badly injured that they died the next day. At the coroner's inquest the following facts developed: The engine had been in excellent condition, and only three days before had undergone some minor shop repairs. Two slight leaks in the boiler had been repaired in the preceding few months, one of them by a patch, but this was found to be perfectly sound after the accident. The wrecked train consisted of the engine and four cars. When approaching Highlands, near Montreal, there was something wrong with the engine. At Highlands the engineer on examination found the engine brake rigging broken and removed part of it, and also found a spring hanger on the left rear driver broken, which he also removed. There was a leak of steam, but not serious enough to prevent the engineer from proceeding the few miles to Montreal, the end of the run. When within some two miles of the terminal, there was a sudden escape of steam and hot water from beneath the left side of the cab, the fireman jumped, and half a mile farther the engineer either fell or jumped (he was badly scalded and later died of his scalds.) The train ran on with open throttle. The other trainmen became alarmed at the high speed of the train through the yard approach, and at a point 1,600 to 2,000 ft. from the station (measured from the bumping block) a brakeman pulled the emergency cord. The brakes went on promptly, but as the engine brake was disconnected there was only the braking power of the four cars to reduce the speed, and the train ran through the bumper and through the brick wall of the station into the waiting-room. On examination it was found that a washout plug on the left side of the firebox had been broken off, and there were marks of the driving-wheel on the side of the firebox. Mr. H. H. Vaughan, Assistant to the Vice-

President, explained the accident as the result of lurching or leaning of the engine due to the broken spring hanger, which allowed the driving-wheel to strike the plug and break it off. The escaping steam and water would not have directly struck the engineer, he being on the other side of the cab, but he probably bent down to see what was the trouble and thus was scalded so badly that he could not shut off steam and apply brakes before falling or jumping. The reduced braking power of the train, Mr. Vaughan testified, would have left the train a speed of some 25 mi. per hr. at the bumping post. The coroner's jury held that there was no negligence shown.

FINAL DECISION IN THE CARTER CASE was rendered at Chicago last week. This is the case in which the United States brought suit against former Capt. O. M. Carter to recover part of the funds obtained by him in the '90's through conspiracy with John F. Gaynor and Benjamin D. Greene in connection with contract work in the Savannah District. When Carter was arrested and brought before the court martial for trial, he turned over funds and securities amounting to several hundred thousand dollars to two of his brothers. These funds were traced to their possession and the Government brought suit for their recovery. A decision rendered a year ago by Judge Kohlsaat of the U. S. Circuit Court at Chicago, awarded these funds to the Government as having been taken from it by fraud, with the exception of $45,000, as to which the Judge held that the chain of evidence to show its fraudulent obtainment was incomplete. In addition the trial judge cast some doubt on the evidence upon which Carter was convicted even though in his decision he concluded the whole evidence to show that Carter came by the funds fraudulently.

The Circuit Court of Appeals for the Seventh Circuit, Judges Grosscup, Baker and Seaman, has just rendered a decision in which they award the entire property to the United States and enter a deficiency judgment against Carter and his brothers for funds which have been dissipated. The Court discusses at length the evidence as to Carter's guilt and says:

> Under the settled facts above recited, linked with cumulative evidence, tending to prove actual knowledge on the part of Captain Carter of the excessive profit in the mattress work and of divisions thereof with Westcott in New York, and complicity in the fraudulent transactions, of which (at one time or another) he acquired approximately one-third of the net proceeds, we are constrained to the belief that the evidence is decisive, not only of fraud perpetrated by the contractors, but of concurrence and participation therein by Captain Carter. * * * * * * * * *
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> As the evidence further establishes, not only personal and business intimacy between Captain Carter and these contractors, but his constant presence with them in New York, upon the monthly visits to settle accounts and divide the proceeds between the contractors and Westcott as before stated, together with the cogent fact that Carter acquired the share of illicit profits turned over to Westcott, we believe the inference of fact to be inevitable, that Captain Carter connived with these parties in thus defrauding the United States.

A BRIDGE WAS DAMAGED BY DYNAMITE near Indiana Harbor, Ind., on March 19, and the matter is attributed to labor troubles. The bridge was a Scherzer bascule bridge (one of those noted in our issue of March 18), but the erection of the steel work had only recently been commenced.

THE BILL TO LICENSE CIVIL ENGINEERS in Idaho, referred to in our issue of Feb. 25, was finally defeated.

THE HAUSER LAKE DAM, near Helena, Mont., the greater part of which was carried away by a flood a year or so ago (see Eng. News, April 30, 1908), was the scene of another accident on March 15. From the meager press reports received, it appears that the cofferdam and other construction works were carried away, and that perhaps some damage was done to the new dam which is reported to have been under construction.

TWO WATER TANKS FAILED at Parkersburg, W. Va., on March 19. It is reported that two lives were lost, five persons were seriously injured, and a number of houses were wrecked. The Parkersburg water-works plant was built by the city in 1885. Water was pumped from the river to the two iron tanks, with a reported capacity of 1,000,000 gals. each.

A POWERFUL RADIOTELEGRAPHY PLANT has been contracted for with the National Electric Signaling Co., of Pittsburg, by the Navy Department. This plant will be located at Washington, D. C., and will be guaranteed to transmit messages 3,000 miles across seas. The aerial transmission system will be supported by a 600-ft. steel tower. The plant is guaranteed to be operative under all atmospheric conditions and to be proof against all interference from all present radiotelegraphic apparatus in use anywhere. It is reported that the Navy operators unsuccessfully tried for four days to interfere with the operation of a preliminary arrangement of the type of apparatus to be used. The cost of the plant is stated as $182,600.

COUNT ZEPPELIN has been making trials of his latest dirigible balloon in the last two weeks. Starts have been made from the workshops on Lake Constance, Germany. It is reported that on March 16 a successful descent was made without special landing apparatus, to a field on the shores of Lake Constance, that it reascended and went to the balloon shed after a few manouvers. On March 21 a trip of 150 miles was made in four hours with 26 persons aboard.

Personals.

Mr. George C. Koons, Supervisor for the Pennsylvania R. R. at Pitcairn, Pa., has succeeded Mr. T. J. Brereton, Assoc. M. Am. Soc. C. E., as Engineer of the Cumberland Valley R. R.

Mr. L. L. Perry, M. Am. Inst. E. E., for several years Electrical Engineer with F. S. Pearson, New York City, has resigned that position. His present address is 74 South Clinton St., East Orange, N. J.

Mr. John S. Worley, Assoc. M. Am. Soc. C. E., has left the Riggs & Sherman Co., of Toledo, Ohio, and has opened an office in the Reliance Bldg., Kansas City, Mo., under the firm name of The J. S. Worley Co., Engineers.

Mr. E. W. Pittman, formerly Chief Engineer of the Pittsburg Steel Construction Co., has been appointed Contracting Engineer for the McClintic-Marshall Construction Co., in charge of territory in the vicinity of St. Louis, Mo.

Lieut.-Commander Ernest L. Bennett, Engineer Officer of the U. S. battleship "Virginia," has been appointed Fleet Engineer of the Atlantic fleet, to fill the vacancy arising from the promotion of Lieut.-Commander Hutch I. Cone, announced in this column March 18.

Mr. W. J. Olcott, President of the Duluth, Missabe & Northern Ry., has resigned and will become President of the Oliver Mining Co., succeeding Mr. Thomas F. Cole. Mr. W. A. McGonagle, First Vice-President of the D., M. & N. Ry., will be promoted to the position vacated by Mr. Olcott.

Mr. J. Otis Burrage, Assoc. M. Am. Soc. C. E, has resigned his position as Assistant Engineer to the City Engineer of San Francisco, Cal, where he was detailed in charge of design of the North Point main intercepting sewer. Mr. Burrage expects to open an office in that city as a sewage expert.

Mr. Charles Fell, Superintendent of the tube and pipe mill departments of the National Tube Co.'s plant at Lorain, Ohio, has been appointed to succeed Mr. A. M. Saunders, M. Am. Soc. M. E., as Superintendent of the same company's plant at McKeesport, Pa. Mr. Saunders has been transferred to the general offices at Pittsburg, Pa.

Obituary.

Christopher J. Heavey, one of the contractors who helped to build the Brooklyn Bridge, died March 17 at his home in Brooklyn, N. Y. He was in the employ of the U. S. Government on construction work during the Civil War and at the time of President Lincoln's assassination he was foreman of the men at work on the President's private car, which was subsequently used to carry Lincoln's body from Washington to Springfield, Ill.

Joel Allen, Chief Draftsman for several years of the Snare & Triest Co., of New York City, died at Montreal, Can., Feb. 15, of pernicious anaemia. Mr. Allen was born at North Hero, Vt., and graduated at the University of Vermont in the class of 1892 with the degree of C. E. He at once entered the employ of the Illinois Steel Co., in Chicago, and remained with that company up to the time of his connection with the Snare & Triest Co. He was obliged by ill health to give up work in July, 1908.

Hershel Main, Chief Engineer, U. S. N., retired, died March 18 at Washington, D. C. He was born at Sterling, Ill., in 1845 and was educated in the schools of Washington, D. C., and afterward at Phillips Exeter Academy. He graduated at the Naval Academy in 1866 and afterward took special studies in marine engineering. In October, 1866, he entered the navy service as Third Assistant Engineer and became Chief Engineer in 1892. He was retired in 1895, for incapacity resulting from incident of service, with the rank of Lieut.-Commander. Chief Engineer Main was aboard the steamer "Saginaw" at the time of its wreck in 1871 and lived for 90 days on a coral reef in the South Pacific with the officers and crew of the wrecked vessel, whom he finally saved, guiding their small boat by means of his sextant to a neighboring island.

Prince Michael Hilkoff, Member of the Council of the Russian Empire, and formerly General Inspector of Government Railways and Minister of Ways of Communication, died March 21 at St. Petersburg, Russia. As a boy he was one of the pages of the Empress, and at the age of 16 years he became an officer in the Imperial Guards, remaining in the army through the Crim... War. Introduced by letters from Czar Alexander ... President Buchanan, he came to America in 1857 ... dy problems of transportation. Prince Hilkoff wo... that time master of six languages. He visited C... and St. Louis and traveled on horseback, by s... and afoot through much of the country west of t... Mississippi, carrying his investigations, in some case... far west as the Rocky Mts. He next spent a yea... European travel and, at the age of 23, entered the ... gn office in St. Petersburg. Returning to America ... 61 under the name of John Magill, he went to wor... Philadelphia, Pa., for a machinist named Wainwr... and was paid one dollar a day. He was now obliged ... make his own way on account of the emancipation o... Russian serfs, which had impoverished his father. ...fter four years in Philadelphia, "John Magill" was ... by Mr. Wainwright to the Argentine Republic wh... the firm had a contract for work on a railway then ...der construction. At this period he was joined by h... wife and children from Russia and all lived on his w... of two dollars a day. In the Argentine he became ... fireman, engineer and eventually round-house superintendent at seven dollars per day.

Prince Hilkoff next went to England and served as an engineer and afterward as a locomotive superintendent. After serving five years in the last-named official position he returned to Russia and was employed on Russian railways, rising step by step until he became the principal assistant of Gen. Annenkoff in the construction of railways in Central Asia and the Trans-Caspian region. He became General Inspector of Government Railways in 1893, and in the following year was made Minister of Ways of Communication. He was of great value to the Russian Government in increasing the efficiency of the Trans-Siberian Ry. during the recent war with Japan.

Engineering Societies.

COMING MEETINGS.

INTERNATIONAL MASTER BOILER MAKERS' ASSOCIATION.
April 27 to 30. Annual meeting at Louisville, Ky. Secy., H. D. Vought, 95 Liberty St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 4-7. Spring meeting at Washington, D. C., Secy., Calvin W. Rice, 29 West 39th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY.
May 6-8. Annual meeting at Niagara Falls, Canada. Secy., Jos. W. Richards, Lehigh University, South Bethlehem, Pa.

AIR BRAKE ASSOCIATION.
May 11-14. Annual meeting at Richmond, Va. Secy., F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
May 18-20. Annual meeting at Cincinnati, Ohio. Secy., Richard Moldenke, Watchung, N. J.

AMERICAN RAILWAY ASSOCIATION.
May 19. Annual meeting at New York City. Secy., W. F. Allen, 24 Park Place, New York City.

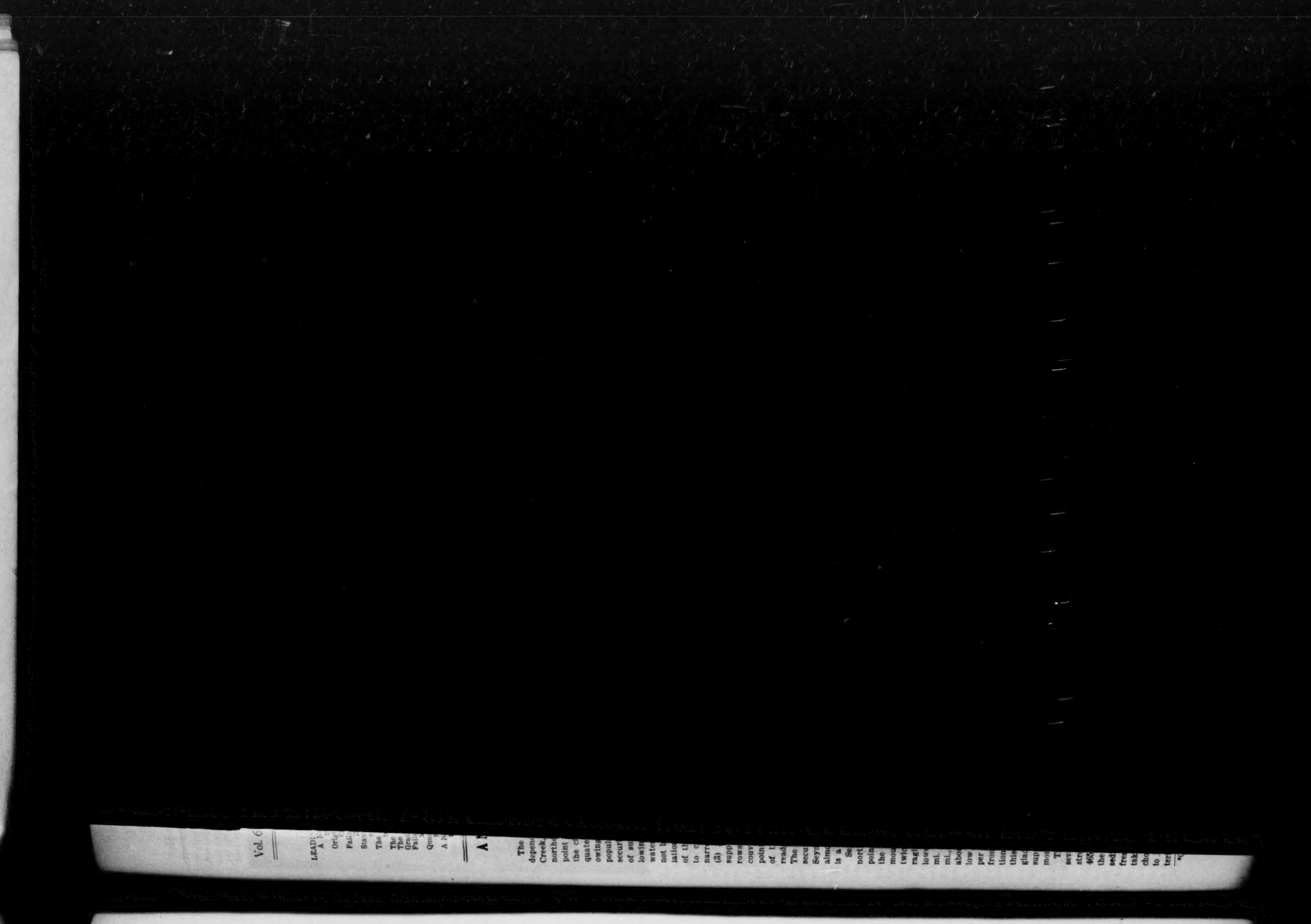
NATIONAL FIRE PROTECTION ASSOCIATION.
May 25-27. Annual meeting at New York City. Secy., W. H. Merrill, 382 Ohio St., Chicago, Ill.

AMERICAN WATER-WORKS ASSOCIATION.
June 8-12. Annual convention at Milwaukee, Wis. Secy., John M. Diven, 14 George St., Charleston, S. C.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 16-18. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

MASTER CAR BUILDERS' ASSOCIATION.
June 21-23. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 39 Old Colony Bldg., Chicago, Ill.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.
June 23-25. Annual meeting at Detroit, Mich. Secy., P. W. Drew, Wisconsin Central Ry., Chicago, Ill.

RAILWAY SIGNAL ASSOCIATION.—At the meeting held at Chicago (in the Auditorium Hotel) on March 15, Mr. E. F. Creighton (General Electric Co.) gave a talk on lightning phenomena, with special reference to signal circuits. This was illustrated by means of apparatus for experiments. Lightning protection was described, together with several forms of lightning arresters. Mr. C. C. Anthony (Pennsylvania Ry.) alluded to a possible danger of a metallic connection being formed between two circuits by the fusing together of the electrodes in a lightning arrester as the result of a lightning discharge. Mr. Creighton replied that experience with a mountain line in Colorado indicated that there was rarely enough electricity in a discharge to produce welding or fusion. Overhead signal wires enclosed in cables prevent induced lightning, or the wires may be protected by running other lines above them.

The system of signal indications presented in a progress report at the last annual meeting was brought up for discussion, and remarks were made both in favor of and in opposition to the system. In the course of this discussion it was stated by Mr. Denney, Signal Engineer of the Lake Shore & Michigan Southern Ry., that his road will soon install a new signal system in connection with its change from left-hand to right-hand running. This change will leave the Chicago & Northwestern Ry. as the only important line running its trains on the left-hand system.